AT-AR240E ADSL Bridge/Router

Web Interface User Manual

Allied Telesyn
Simply connecting the world

Release 1-2-0

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Part Number: 613-50197-00 Rev D

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Preface

Purpose of this Manual

This manual is the complete reference for the AT-AR240E ADSL Bridge/Router web interface that allows the user to initialise, view and modify the router configuration in order to match the characteristics of the related network environment. Using this web interface the user has the ability to configure the following services:

- *ADSL router*
- *ADSL Bridge*
- *Security*
- *DHCP Client-Server/Relay*
- *DNS Client/Relay*
- *LAN and USB interfaces*
- *IP Routing*

Using the web it is also possible to:

- *Save the configuration*
- *Restart the router*
- *Check the system status*
- *View error log*
- *Define new users for management*

☞ *The AT-AR240E Console is provided to configure and show the status of the SNMP module.*

Intended Audience

This manual is intended for the system administrator, network manager or communications technician who will configure and maintain the AT-AR240E.

It is assumed that the reader is familiar with:

- The topology of the network in which the *AT-AR240E* is to be used.
- Basic principles of computer networking, ADSL protocols, IP protocols and routing, and interfaces.
- Administration and operation of a computer network.
- *This manual is not intended for users who will use the computer network to access network services from their terminal, personal computer or workstation.*
- Most of the configurations described in this manual require *Administrator* privilege.

Structure of this Manual

This manual is organised into the following chapters:

- *Chapter 1, Overview introduces the AT-AR240E ADSL Bridge/Router, its Web interface and the related network environment.*
- *Chapter 2, Configuring the ADSL interface gives an introduction to the ADSL technology, describes the main concepts of an ATM network, its Quality of Service parameters and all the protocols supported by the AT-AR240E to establish an ADSL connection.*
- *Chapter 3, LAN-USB gives a brief introduction to the IP protocol and describes how to configure the LAN - USB interfaces on the AT-AR240E. It describes also how to add/modify/remove static routes within the router.*
- *Chapter 4, DHCP gives a brief introduction to the Dynamic Host Configuration Protocol and describes how to configure the DHCP server/relay services on the AT-AR240E*
- *Chapter 5, DNS gives an introduction to the Domain Name System and describes how to configure the DNS client/relay services on the AT-AR240E*
- *Chapter 6, Security describes all the supported features concerning the Firewall, the "Dynamic Port Opening", the "Attack Detection and Blocking" and the NAT services on the AT-AR240E*
- *Chapter 7, SNMP gives an introduction to the SNMP protocol and describes how to access to the AT-AR240E Console for configuring the SNMP module*

Standards and Protocols

Supported Standards and Protocols

Table 1 lists the protocols and standards supported by the AT-AR240E ADSL Bridge/Router and the references where these protocols and standards are defined.

Table 1: Protocols and standards supported by the AT-AR240E ADSL Bridge/Router.

Protocol/standard	Reference
DHCP	RFCs 1541, 1542.
Encapsulation over ATM	RFC 1483
IP	RFCs 791, 821, 950, 951, 1009, 1055, 1122, 1144, 1349, 1542, 1812, 1858.
IP addressing	RFC 1597.
IP over ATM	RFC 1577
PPP over ATM	RFC 2364
PPP over Ethernet	RFC 2516
SNMP, MIBs	RFCs 1155, 1157, 1213, 1239, 1315, 1398, 1493, 1514, 1573, 2233.

Obtaining Copies of Internet Protocols and Standards

The Internet Protocols are defined in *Requests For Comments* (RFCs). RFCs are developed and published under the auspices of the *Internet Engineering Steering Group* (IESG) of the *Internet Engineering Task Force* (IETF). For more information about the IESG and IETF, visit the IETF web site at `http://www.ietf.org/`.
For more information about RFCs and Internet Drafts (the starting point for RFCs), visit the RFC Editor web site at `http://www.rfc-editor.org/`. This site has information about the RFC standards process, archives of RFCs and current Internet Drafts, links to RFC indexes and search engines, and a list of other RFC repositories.

RFCs can be obtained electronically from many RFC repositories, mail servers, World Wide Web (WWW), Gopher or WAIS sites. A good starting point for finding the nearest RFC repository is to point your Web browser at `http://www.isi.edu/in-notes/rfc-retrieval.txt`.

To obtain a copy of an RFC using FTP, FTP to the host and login as user `anonymous`, and a password of either `guest` or your email address. The FTP server will usually prompt you for one or the other. Use the `get` command to retrieve the desired RFC. Most sites have a file, usually `rfc-index.txt`, which lists the titles and file names of all available RFCs. Most sites have a file, usually `rfc-retrieval.txt`, which gives detailed information about RFC repositories and how to retrieve RFCs via FTP, mail servers, WWW, Gopher and WAIS.

To learn how to obtain a copy of an RFC via email from a mail server, point your browser at `http://www.isi.edu/in-notes/rfc-editor/rfc-info`.

To obtain a copy of an RFC from a Web site, or to search RFC repositories for a specific RFC or all RFCs relating to a topic, point your Web browser at `http://www.rfc-editor.org/rfc.html`.

Background Reading

For an introduction to the Internet Protocols refer to:

> *DDN Protocol Handboo*k, Elizabeth J. Feinler, 1991, DDN Network Information Center, SRI International, 333 Ravenswood Avenue, Menlo Park, CA 94025, USA. Email: nic@nic.ddn.mil.
>
> *Internetworking with TCP/IP — Volume I: Principles, protocols and architecture (2nd Edition*), Douglas E. Comer, 1991, Prentice-Hall International, Inc., New Jersey. ISBN 0-13-474321-0.
>
> *Internetworking with TCP/IP — Volume II: Design, implementation, and internal*s, Douglas E. Comer and David L. Stevens, 1991, Prentice-Hall International, Inc., New Jersey. ISBN 0-13-472242-6.
>
> *Internetworking with TCP/IP — Volume III: Client-server programming and application*s, Douglas E. Comer and David L. Stevens, 1993, Prentice-Hall International, Inc., New Jersey. ISBN 0-13-474222-2.

For a description of layered protocols refer to:

> *Computer networks (2nd Edition*), Andrew S. Tanenbaum, 1989, Prentice-Hall International, Inc., New Jersey. ISBN 0-13-162959-0.

For an introduction to network management refer to:

> *The simple book — An introduction to management of TCP/IP-based Internet*s, Marshall T. Rose, 1991, Prentice-Hall International, Inc. ISBN 013812611-9.

For an introduction to ADSL refer to:

> *ADSL: Standards, Implementation and Architecture*, Charles K. Summers, CRC Press Advanced and Emerging Communication Technologies Series CRC Press; ISBN: 084939595X; (June 1999).

For an introduction to PPP refer to:

Using and Managing PPP, Andrew Sun, O'Reilly; ISBN: 1565923219; (March 1999).

Publicly Accessible Documents

Allied Telesyn maintains an online archive of documents and files that customers can access via the World Wide Web or via anonymous FTP. For WWW access, point your Web browser at `http://www.alliedtelesyn.com`.

Conventions

A number of symbols, typographic and stylist conventions are used throughout this manual to aid learning and make information easier to find (Table 2).

Table 2: Typographic conventions used in this manual.

This typeface	Is used for
Italic	Referring to another section in this manual or another manual, or to introduce and emphasise new terms. For example, "See *Chapter 2, ADSL*".
`Monospace`	Text as it appears on-screen, or anything you must type.
0xFF	Numbers starting with the 0x prefix are hexadecimal values.
Attention	A special keystroke known as the attention character, which will be either [Break] or [Ctrl/P].

☞ *Note. A note like this presents additional information or interesting sidelights.*

⚠ *Warning. A warning alerts you to situations in which you could do something that might result in a loss of data, or cause damage to the equipment.*

Chapter 1

Overview

Introduction

Overview of the AT-AR240E ADSL Bridge/Router

The AT-AR240E ADSL Bridge/Router provides data access for multiple users in Small Office/Home Office (SOHO), Small to Medium Enterprise (SME) or Branch Offices wanting very fast download speeds or who need to combine broadband access with a telephone service (*see Figure 1*).

ADSL, a high bit rate digital subscriber line access technology, provides asymmetrical data over a single pair of local loop copper. Users can access the Internet, corporate LAN or Video on Demand services, downloading at speeds up to 8Mbps and uploading data at speeds of up to 1Mbps.

The AT-AR240E ADSL Bridge/Router implements the ITU standards G.992.1 (G.DMT), G.922.2 (G.lite) and ANSI (T1.413) for operation over mixed gauge two-wire circuits and is interoperable with all major DSLAM and Multi Service Access Systems. When used with a POT's Splitter the AT-AR240E ADSL Bridge/Router can be used in conjunction with a telephony service using the same two-wire local loop circuit.

Affordable broadband access is provided without compromising performance, security or routing capability.

The Router provides a 10Mbps Ethernet and a USB Interface for connection to the office LAN and it supports automatic assignment of IP addresses to personal computers via a built-in Dynamic Host Configuration Protocol (DHCP) server.

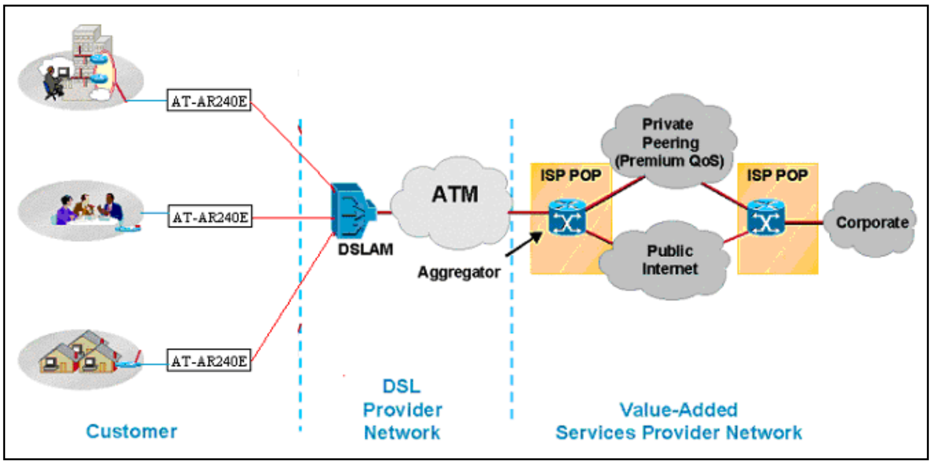


Figure 1. ADSL Network topology

An advanced Security system provides the following services (*see Chapter 6 for details*):

- Firewall
- Dynamic Port Opening
- Attack Detection and Blocking
- Advanced Network Address Translation (NAT)

Customers using the AT-AR240E ADSL Bridge/Router may decide to create up to four independent routed ADSL connections (each with full routing capability and selectable QoS parameters) or one Bridged ADSL connection. IP address assignment can be either static or dynamic per virtual ATM connection.

How to start the web interface

To run the AT-AR240E web interface, ensure that your Web Browser is Microsoft® Internet Explorer 5.0 (or later) and disable any proxy settings on your Web Browser as follows:

☞ *Steps may vary, depending on the Browser version.*

- Double-click on the Internet Explorer icon.
- Click `Tools` > `Internet Options`.
- Select the "`Connections`" tab.
- Click on the LAN Settings button. Ensure that the use of Proxy Server is disabled.
- Click OK for changes to take effect.

The default IP address on the AT-AR240E is 192.168.1.1.

The IP address on your PC has to be in the same subnet as 192.168.1.1. It is outside the scope of this manual to explain how to achieve this setting on your PC.

After connecting to the default IP address http://192.168.1.1:8080 the Web interface will ask for the username and password to access the system. Default settings for these parameters are:

```
Username: manager
Password: friend
```

Performing Basic Tasks

Status

The AT-AR240E has three physical ports: the ADSL, the LAN and the USB. Using the Web interface, clicking on `STATUS` it is possible to check the status of each port.

As shown in Figure 2, each physical port has an associated virtual LED indicating the presence of the related physical link. A **GREEN** virtual LED indicates the presence of the link; otherwise a **RED** virtual LED is shown.

The `STATUS` web page also provides some useful statistics on all the created ADSL connections (*see Chapter 2 for details*); it is also possible to check the status of both the LAN and the USB interfaces.

The `STATUS` web page provides a view on the AT-AR240E Security system through the following buttons: ---- `'Firewall'`, `'Dynamic Port Opening'`, `'Attack Detection and Blocking'` and `'NAT'` (*see Chapter 6 for details*).

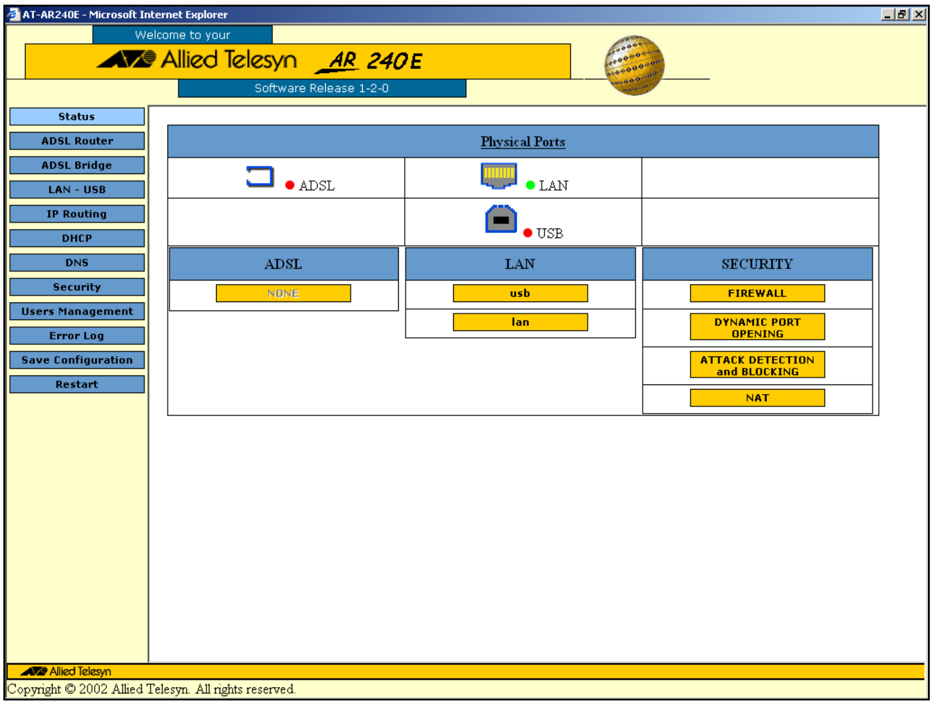


Figure 2. Web interface Status Page

User Management

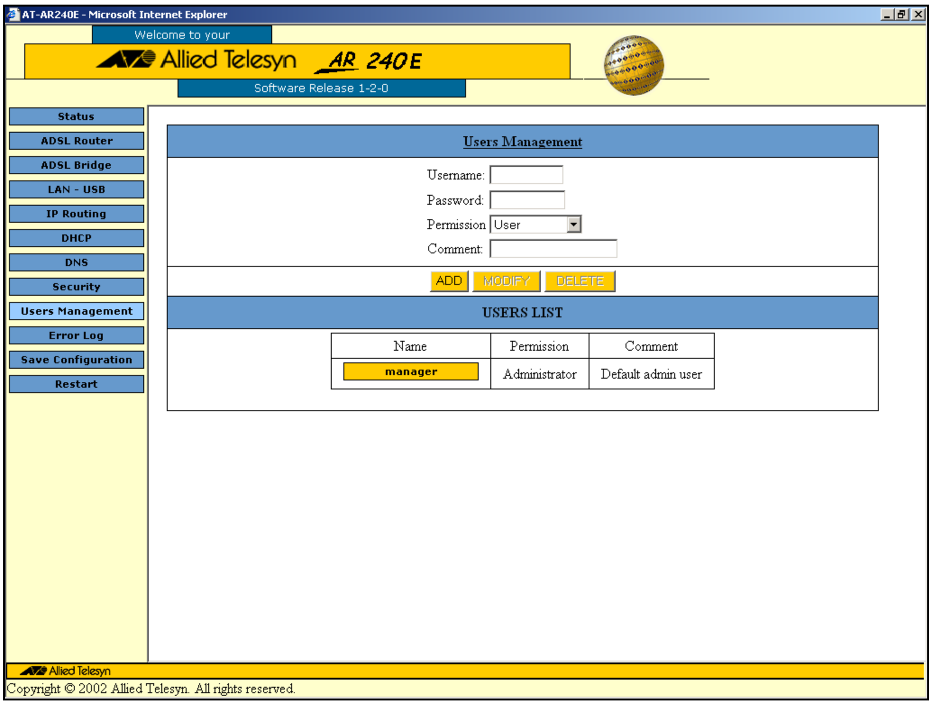
Clicking on 'Users Management' enables the definition of new users. Two kind of users are defined (*see Figure 3*):

- Normal User
- Administrator

☞ *A normal user is only able to view and check the status of the AT-AR240E without having any configuration privileges.*

To add or modify a User the following parameters have to be added:

- `Username`: a string with a length in the range [1,60]
- `Password`: a string with a length in the range [1,60]
- `Permission`: two choices are available: User or Administrator
- `Comment`: a max 60 chars string



Users Management

Username:	
Password:	
Permission	User
Comment:	

USERS LIST

Name	Permission	Comment
manager	Administrator	Default admin user

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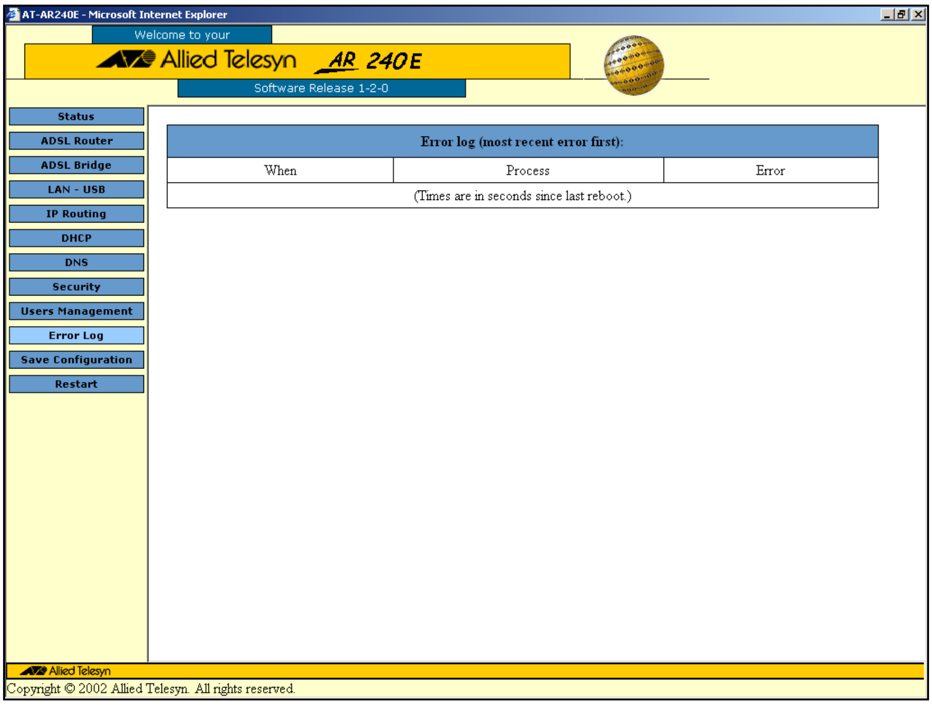
Figure 3. Web interface User Management page

Error Log

Clicking on 'Error Log' displays a table as shown in Figure 4. This table shows some useful information on configuration errors:

- When: time in seconds since last reboot
- Process: the process that caused the error
- Error: the error description



Error log (most recent error first):		
When	Process	Error
(Times are in seconds since last reboot.)		

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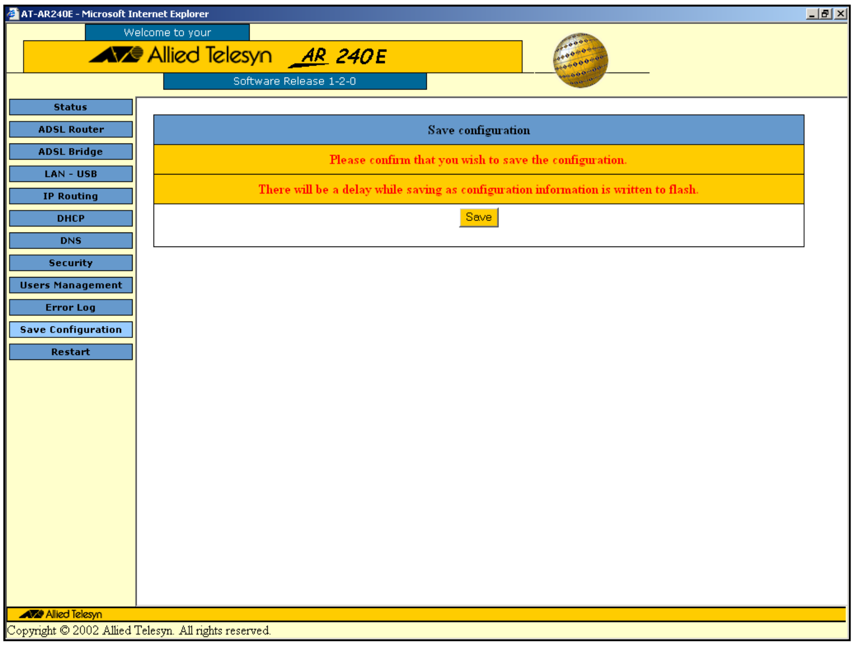
Figure 4. Web interface Error Log page

Save Configuration

The '`Save Configuration`' section provides the opportunity to store into the internal flash all the configuration settings made by the AT-AR240E administrator (*see Figure 5*).



Save configuration

Please confirm that you wish to save the configuration.

There will be a delay while saving as configuration information is written to flash.

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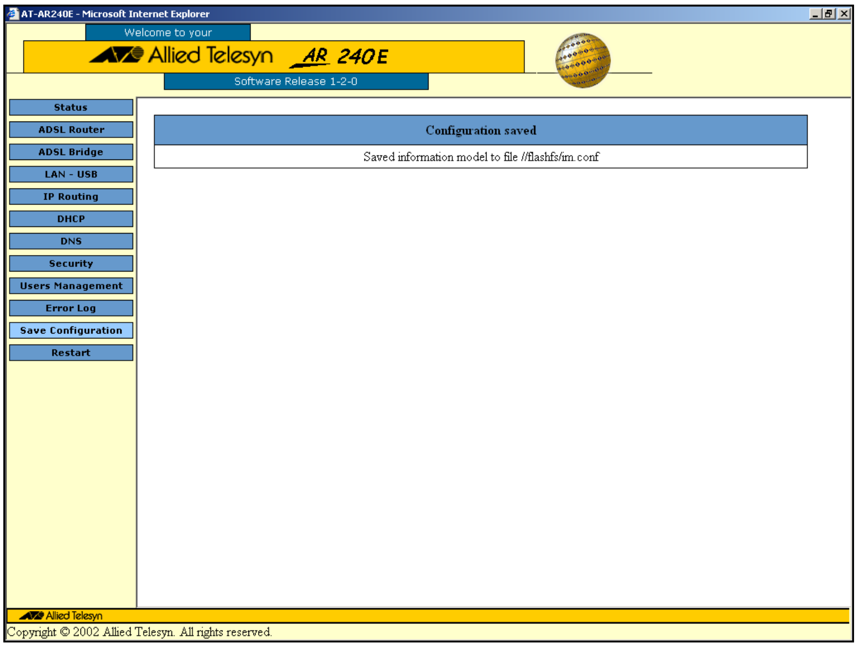
Figure 5. Save Configuration

There will *be* a delay (approximately 15 secs) for saving the configuration. After the configuration has been saved the following web page will appear:



Configuration saved

Saved information model to file //flashfs/im.conf

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Figure 6. Configuration saved

Restart

Clicking on '`Restart`' forces a Software restart on the AT-AR240E (*see Figure 7*).

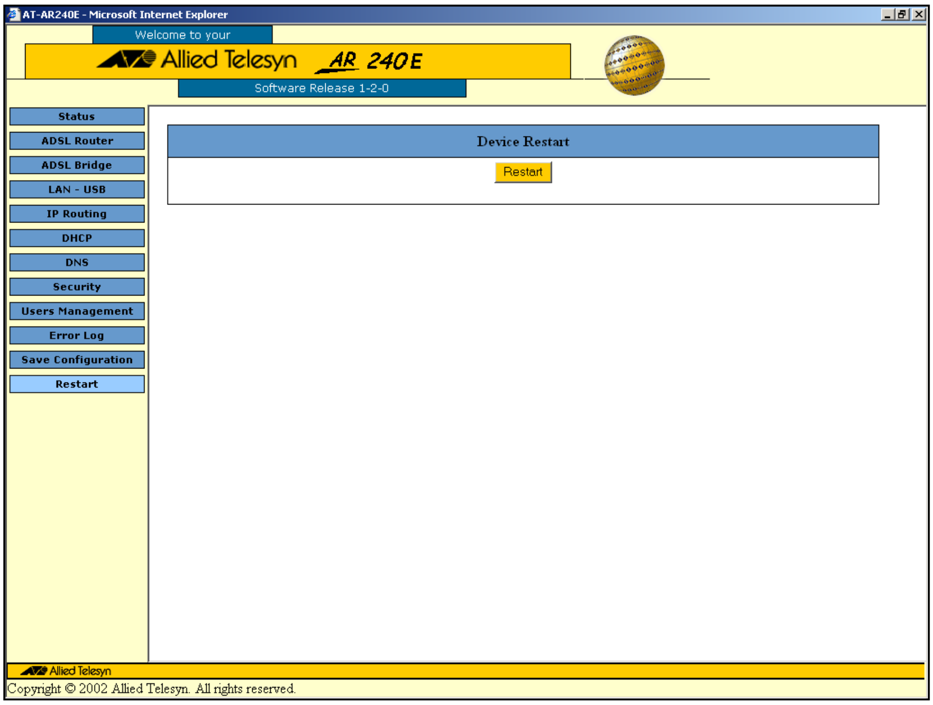

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Figure 7. Web interface Restart page

Chapter 2

Configuring the ADSL Interface

Introduction to ADSL

ADSL, short for *Asymmetric Digital Subscriber Line*, is an exciting new technology that utilizes existing telephone lines for multimedia and high-speed data communications in parallel with the regular telephone voice services.

It operates over a single, twisted copper pair of wires and provides the connection using a pair of modems, one at the user end and the other at the Exchange. The modems/routers are designed to exploit the physical transmission capabilities of copper lines beyond the frequencies used for normal telephony services to achieve data rates higher than can be achieved by analogue voiceband modems.

The asymmetric in ADSL is due to the fact that the downstream (towards the customer) data rate is much higher than the upstream (towards the network) data rate. ADSL can be viewed as a high speed data pipe that can be used to transmit any high speed data application, such as video conferencing, fast Internet access, interactive multimedia, on-line home banking, remote office or remote LAN applications, telecommuting.

Internet Connectivity

The explosion of interest in the Internet has created a clear opportunity to provide high-speed Internet access to homes and small businesses. ADSL can deliver not only higher speed, but also an "always on" service that does not risk call blocking in the telephone network.

Branch Office Connectivity

Most business PC applications, such as file access, e-mail, terminal, and emulation, perform asymmetric communication, making ADSL an appropriate technology to connect a remote office to the enterprise.

Telecommuting

Telecommuting is another ripe opportunity for ADSL technology. With high-speed connectivity to employees' homes, a "virtual office" experience to telecommuters can be offered. This is attractive because more and more corporations are embracing telecommuting as an effective means of reducing facility expenses and complying with environmental quality regulations.

Business-to-Business

Today's connected information society is creating new types of business relationships and providing new opportunities in more traditional business contexts. Businesses that have a common bond may want to share a private and secure network infrastructure. A virtual private network can be created using ADSL in conjunction with existing backbone networks to interconnect businesses.

Content Delivery

Although a high-bandwidth network connection is attractive in itself, it can be made even more compelling by enhancing the quality and quantity of content accessed. Content can take many forms: shopping catalogues, reference materials, real estate listings, yellow pages, travel services, games, music, video, etc. The combination of high-speed networks and enriched content presents an attractive offering to business and residential consumers.

ADSL services

Both if you want to use the AT-AR240E as a Bridge or as a Router using its web interface it is possible to configure four different ADSL services that are:

- Multi (Auto)
- ANSI (T1.413)
- G.DMT
- G.Lite

Your service provider will most likely have specified which service you should choose. If in doubt choose MULTI(AUTO). The characteristics of each service are briefly described below.

MULTI (AUTO)

Using this setting, the DSL configuration is automatically configured during the ADSL link establishment.

ANSI T1.413 and G.DMT

ANSI T1.413 and G.DMT are very similar. G.DMT really is the International variant of the original American ANSI standard.

They both define what is referred to as 'Full Rate" ADSL. This means a service that provides downstream data rates up to 6Mbps and upstream data rates up to 1.5M bps. Note that these are the maximum possible data rates on such a service. They are not necessarily the data rates that every subscriber to the service will receive.

Just like all other flavors of DSL, data rates decrease as distance from the CO (Central Office) increases.

At 12,000 to 18,000 feet away from the CO, G.DMT ADSL delivers up to 1.5Mbps downstream and up to 384 Kbps upstream. G.DMT is excellent for Web surfing and applications that involve downloading large files from the Internet.

Table 3: G.DMT features.

G.DMT Asymmetric Speeds Range	Best Applications	Maximum Distance from CO
1.5 to 6 Mbps Downstream; 16 to 640 Kbps Upstream	Internet/Intranet access, Web surfing, large files download, video-on-demand, VPN. Analog voice support via installation of a splitter.	18,000 feet or 3.4 miles

G.Lite ADSL

G.Lite ADSL is also known as universal ADSL. G.Lite ADSL is a new standard for ADSL service that does not require your local phone company to send a technician to your site for installation, thus passing on the savings to end-customers.

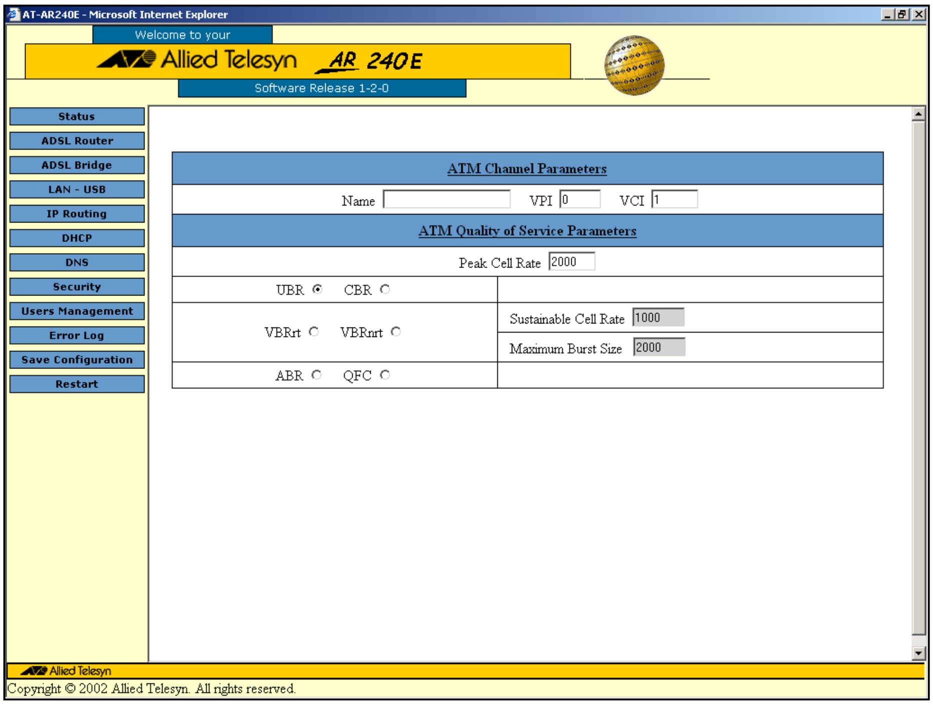
G.Lite offers maximum downstream speeds at up to 1.5 Mbps and maximum upstream speeds at up to 384 Kbps. G.Lite is excellent for Web surfing and applications that involve downloading large files from the Internet.

Table 4: G.Lite features.

G.Lite Asymmetric Speeds Range	Best Applications	Maximum Distance from CO
Up to 1.5 Mbps Downstream; up to 384 Kbps Upstream	Internet/Intranet access, Web surfing, large files download, video-on-demand, VPN. Analog voice support via filter only (no need to install splitters)	18,000 feet or 3.4 miles

ATM Parameters

If you plan to use the AT-AR240E either as an ADSL Bridge or as an ADSL Router you will have to set the ATM parameters. These parameters (*see Figure 8*) are used to configure the ATM service that runs over your ADSL line. Your service provider may have specified the values to choose.



ATM Channel Parameters

Name: VPI: 0 VCI: 1

ATM Quality of Service Parameters

Peak Cell Rate: 2000

● UBR ○ CBR

○ VBRrt ○ VBRnrt — Sustainable Cell Rate: 1000; Maximum Burst Size: 2000

○ ABR ○ QFC

Figure 8. ATM parameters

The following is a brief explanation of each of these parameters.

ATM Channel Parameters

The following parameters identifies the ATM channel:

- `Name:` an identifier of the connection
- `VPI/VCI:` Virtual Path Identifier and Virtual Channel Identifier identify the ATM channel

ATM Quality of Service Parameters

These parameters are normally left at default settings. For advanced users the following information may be useful.

The following parameters are used for setting the quality of Service on the ATM Channel. You need to specify the Peak Cell Rate, and then choose one of the six possible bit-rate options.

PCR (PEAK CELL RATE)

The maximum speed at which it is possible to send traffic on the connection. It is defined within this range [3,2500]

BIT-RATE OPTIONS

- `UBR (Unspecified Bit Rate):` may be interpreted as "best effort service"
- `CBR (Constant Bit Rate):` this service class is intended for real time applications requiring constrained delay and delay variation
- `VBRrt/VBRnrt (Real time/Non real time Variable Bit Rate):` the first is intended for real-time applications (voice and video applications), the second is for non-real time applications (file transfer). These services are also characterized by:
    - `SCR (Sustainable Cell Rate):` defined in the range [2,2499]
    - `MBR (Maximum Burst Size):` defined in the range [0,5000]
- `ABR (Available Bit Rate):` this service supports instantaneous access to unused network bandwidth with very low cell loss rates comparable to link error rates.
- `QFC (Quantum Flow Control):` is an ATM protocol supporting the ABR necessary to support bursty applications for which bandwidth requirements are difficult to predict in advance.

For a full explanation of ATM, and the meaning of these parameters, see Appendix A.

Configuring the Connection type

A common parameter that is required for several of the available connection types is 'encapsulation'. Here is a brief explaination of encapsulation.

Encapsulation

The purpose of encapsulation is to enable several different data protocols to share an atm line. The encapsulation provides a method of determining which packets belong to which protocol.

- **VCMux**

In VC Based Multiplexing, the transmitted network interconnect protocol is identified implicitly by the VC connecting the two ATM stations, i.e. each protocol must be carried over a separate VC.

There is therefore no need to include explicit multiplexing information in the Payload of the frame. This results in minimal bandwidth and processing overhead.

VC Based Multiplexing will be dominant in environments where dynamic creation of large numbers of ATM VCs is fast and economical.

Use `Bridged VCMux` to create a connection that uses bridged protocols, while `Routed VcMux` should be used for routed protocols.

- **LLC/SNAP**

LLC/SNAP Encapsulation is used when several protocols are carried over the same VC. In order to allow the receiver to properly process the incoming frame, the Payload Field must contain information necessary to identify the protocol of the routed or bridged PDU.

In LLC/SNAP Encapsulation this information is encoded in an LLC/SNAP header placed in front of the carried PDU. LLC/SNAP Encapsulation is desirable when it is not practical for one reason or another to have a separate VC for each carried protocol.

This is the case, for example, if the ATM network only supports (semi) Permanent Virtual Circuits (PVCs) or if charging depends heavily on the number of simultaneous VCs.

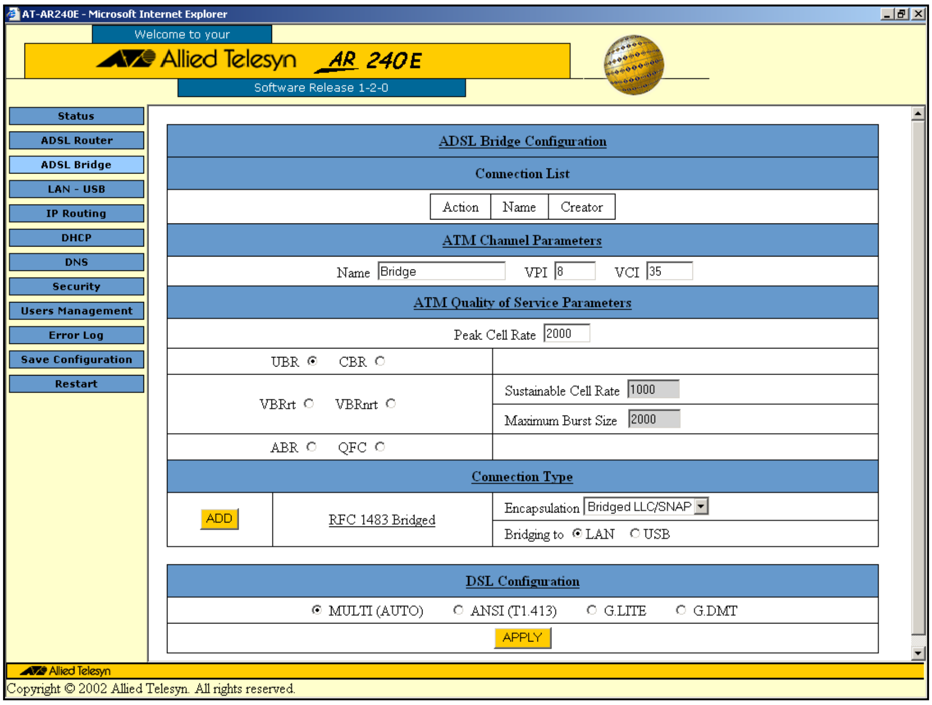
Use Bridged LLC/SNAP to create a connection that uses bridged protocols, while Routed LLC/SNAP should be used for routed protocols.

AT-AR240E as a bridge

The AT-AR240E can be used as a bridge.

☞ *The AT-AR240E cannot manage routed and bridged connections at the same time*

When you configure the AT-AR240E as a bridge you have to decide whether you are bridging from the LAN or from the USB interface (*see Figure 9*).
Using a Bridged Connection, you will usually be allocated one or more IP addresses from your service provider. These are the IP addresses to be used on the PCs on your LAN (or USB). This is because the PCs are the devices that will be exchanging IP packets with external devices. As your router is acting as a bridge, it will be transparent to external devices. It will transfer packets going in and out of your LAN (or USB) , but it will not itself directly exchange IP packets with external devices.



ADSL Bridge Configuration

Connection List

Action	Name	Creator

ATM Channel Parameters

Name Bridge VPI 8 VCI 35

ATM Quality of Service Parameters

Peak Cell Rate 2000

UBR ● CBR ○	
VBRrt ○ VBRnrt ○	Sustainable Cell Rate 1000 Maximum Burst Size 2000
ABR ○ QFC ○	

Connection Type

ADD	RFC 1483 Bridged	Encapsulation Bridged LLC/SNAP Bridging to ● LAN ○ USB

DSL Configuration

● MULTI (AUTO) ○ ANSI (T1.413) ○ G.LITE ○ G.DMT

APPLY

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Figure 9. AT-AR240E as a bridge

When bridging an interface (e.g. LAN), it is necessary to allocate an IP address to the bridged port (e.g. LAN) of the router in order to enable management access from PCs that are connected to the bridged interface.
To ensure that access to the router from PCs on the bridged interface is possible, the IP address allocated to the router's bridged interface needs to be in the same IP subnet as the addresses being used on the PCs.

After selecting the `RFC1483 Bridged` radio button as shown above (*see Figure 9*) you will also need to specify:

- the Encapsulation (*see discussion on Encaspulation on page 27*)
- the interface used for bridging (LAN or USB)

It is worth noting that even when the LAN interface is being bridged, it is still possible to manage the AT-AR240E using the other interface (e.g. USB), by connecting to its address (e.g. default value for USB interface is 192.168.2.1, and so is access from the web browser by typing http://192.168.2.1:8080 into the address field of the web browser).
This is possible due to the fact that when one interface (e.g. LAN) is bridged, then the other (e.g. USB) will automatically route all packets to the bridge.

AT-AR240E as a router

The AT-AR240E can be used as an ADSL router device.

☞ *The AT-AR240E cannot manage routed and bridged connections at the same time*

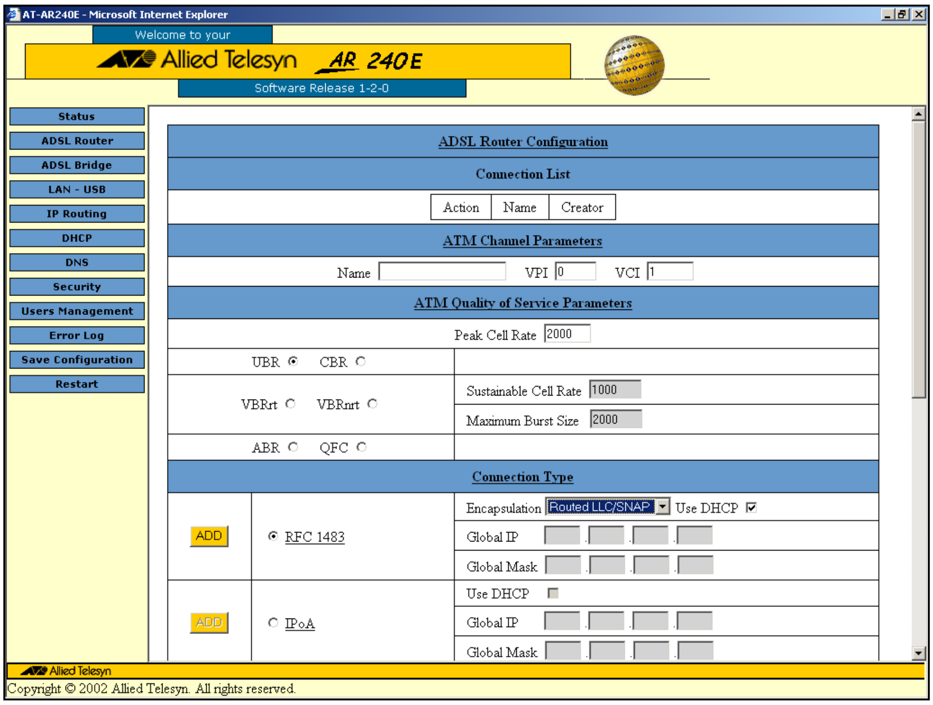
Acting as a router the AT-AR240E makes available the following connection types:

- RFC1483, IPoA, PPP over ATM (PPPoA), PPP over Ethernet (PPPoE)

RFC1483 connection

If your Connection type is RFC1483 than choose the RFC1483 Routed radio button as shown below (*see Figure 10*).
You will also need to specify:

- the Encapsulation (*see discussion on Encaspulation on page 27*)
- the Global IP and the Global Mask. These may need to be manually set or may be automatically configured using the DHCP service provided by your service provider.
  - if they are to be manually configured, then fill in the fields
    - the Global IP
    - the Global Mask
  - if they are to be automatically configured, then just check the Use DHCP checkbox.



ADSL Router Configuration

Connection List

Action	Name	Creator

ATM Channel Parameters

Name ____ VPI 0 VCI 1

ATM Quality of Service Parameters

Peak Cell Rate 2000

UBR ● CBR ○

VBRrt ○ VBRnrt ○ Sustainable Cell Rate 1000 Maximum Burst Size 2000

ABR ○ QFC ○

Connection Type

● RFC 1483 — Encapsulation Routed LLC/SNAP Use DHCP ☑ Global IP . . . Global Mask . . .

○ IPoA — Use DHCP □ Global IP . . . Global Mask . . .

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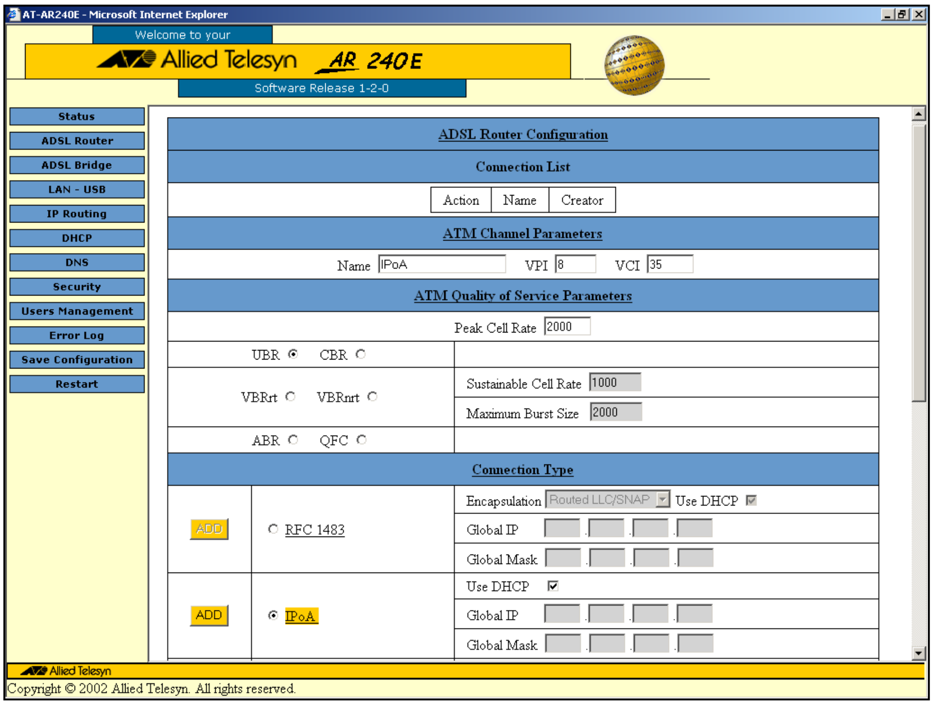
Figure 10. RFC1483 Routed Connection

IP over ATM connection

An explanation of IP over ATM can be seen in Appendix C.

Configuration Example for an IP over ATM Connection



ADSL Router Configuration

Connection List

Action	Name	Creator

ATM Channel Parameters

Name IPoA VPI 8 VCI 35

ATM Quality of Service Parameters

Peak Cell Rate 2000

UBR ● CBR ○

VBRrt ○ VBRnrt ○ Sustainable Cell Rate 1000 Maximum Burst Size 2000

ABR ○ QFC ○

Connection Type

ADD ○ RFC 1483 Encapsulation Routed LLC/SNAP Use DHCP ☑ Global IP . . . Global Mask . . .

ADD ● IPoA Use DHCP ☑ Global IP . . . Global Mask . . .

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Figure 11. IP over ATM Connection

If your Connection type is IP over ATM than choose the `IPoA` radio button as shown above (*see Figure 11*).
You will also need to specify:

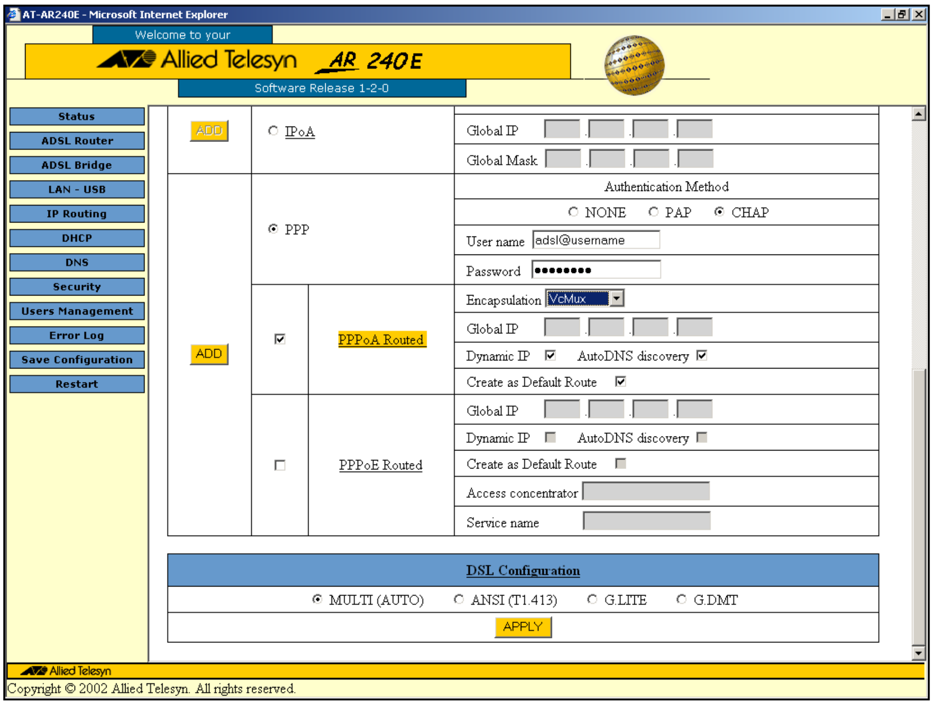
- The `Global IP` and the `Global Mask`. These may need to be manually set or may be automatically configured using the DHCP service provided by your service provider.

  - If they are to be manually configured, then fill in the fields
    the `Global IP`
    the `Global Mask`
  - If they are to be automatically configured, then just check the `USE DHCP` checkbox.

PPP over ATM connection

An explanation of PPP and PPP over ATM can be seen in Appendix D.

Configuration Example for a PPP over ATM Connection



○ IPoA — Global IP; Global Mask

● PPP — Authentication Method: ○ NONE ○ PAP ● CHAP

User name: adsl@username

Password: ••••••••

☑ PPPoA Routed — Encapsulation: VcMux; Global IP; Dynamic IP ☑ AutoDNS discovery ☑; Create as Default Route ☑

□ PPPoE Routed — Global IP; Dynamic IP □ AutoDNS discovery □; Create as Default Route □; Access concentrator; Service name

DSL Configuration: ● MULTI (AUTO) ○ ANSI (T1.413) ○ G.LITE ○ G.DMT

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Figure 12. PPP over ATM Connection

If your Connection type is PPP over ATM then choose the PPP radio button and check the `PPPoA Routed` option as shown above (*see Figure 12*).
You will also need to specify:

- the `Authentication Option`: PAP, CHAP or NONE (`e.g. CHAP`)
- the `Authentication Parameters:`
  - `Username`
  - `Password`
- the `Encapsulation` (*see discussion on Encaspulation method on pag 27*)
- the `Global IP`. This may need to be manually set or may be automatically configured using the service provided by your service provider
  - if it is to be manually configured, then fill in the field `Global IP Address`
  - if it is to be automatically configured, then just check the `Dynamic IP` checkbox

- The purpose of AutoDNS Discovery is to automatically obtain the address of a DNS server that the router can use
- the `Create as Default Route` radio button, if checked, will create the default route via this connection

PPP Over Ethernet Routed Connection

PPP Over Ethernet introduction

PPP, which was designed for serial communications, has now been adapted to Ethernet, and is appropriately called PPP over Ethernet (PPPoE). Since PPP was designed to do things that were either impossible or unnecessary with Ethernet, users are often confused as to why one would want to use PPP over Ethernet at all.

If we were to compare TCP/IP traffic to vehicle traffic, the basic TCP/IP protocol would be comparable to a network of city streets. Streets can serve many access points. It is easy to get on to and off the street.

Additional access points can be added with little disruption. It is hard to tell how many cars are actually using each street. PPP, on the other hand, would be comparable to a railway. Travel is generally between two well defined points. You can't get on and off anywhere. It is relatively easy to count and monitor passengers. You need a ticket to board.

If this is true, then is not PPPoE like running railway tracks down main street? In fact, yes, it is. That is what tramways do. Without disturbing main street traffic, they bring the advantages of railways. They offer speedy access between two well defined points and allow you to count passengers. And you

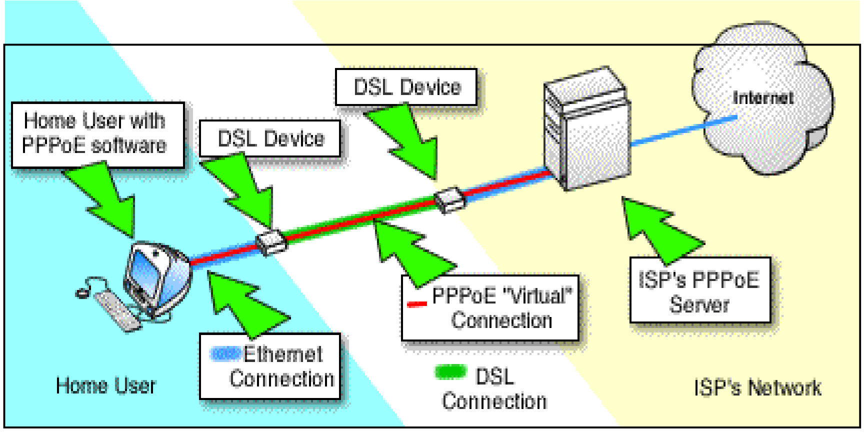


Figure 13. PPPoE allows ISPs to monitor the volume of traffic that their users generate.

PPP over Ethernet brings this sort of functionality to ISPs that do not use serial links to connect their users. Serial ISPs already use PPP over modem communications. DSL providers on the other hand use Ethernet, not serial communications. Because of this, many require the added functionality of PPP over Ethernet, which allows them to secure communications through the use of user logins and have the ability to measure the volume of traffic each u

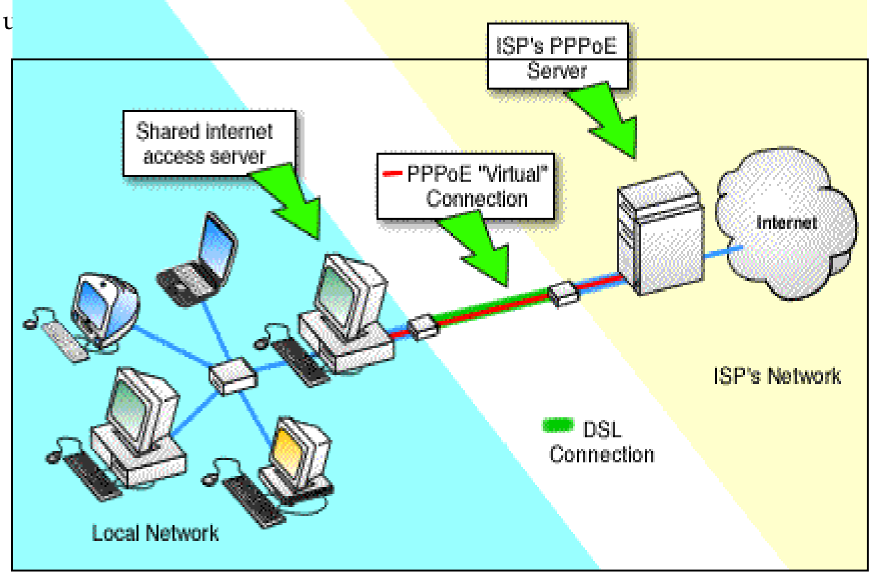
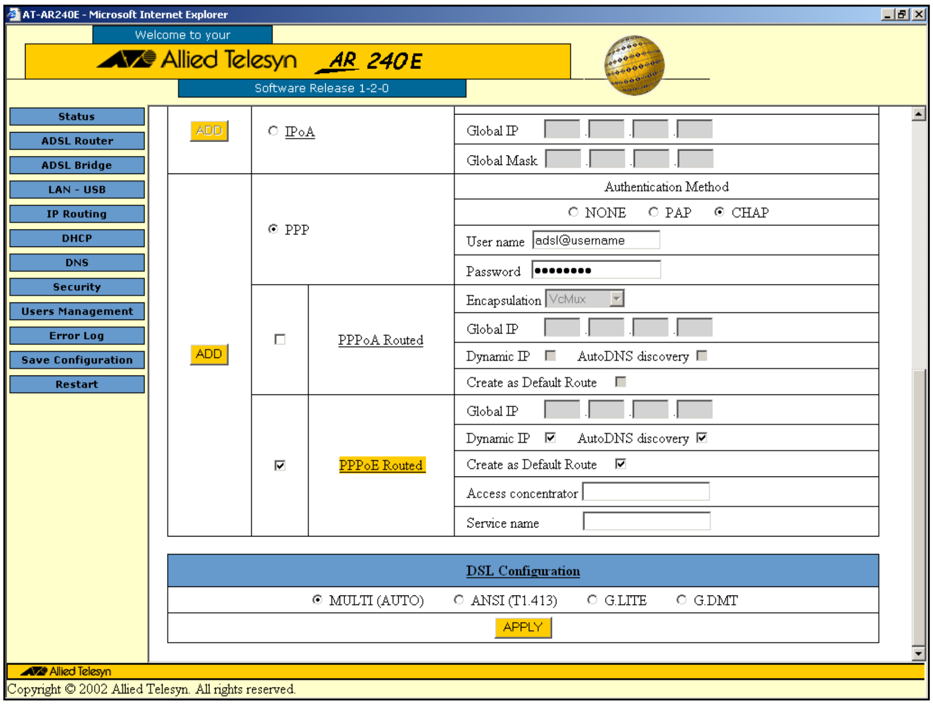


Figure 14. **PPPoE on a Local Network.**

Configuration Example for a PPP over Ethernet Routed Connection



○ IPoA — Global IP; Global Mask

● PPP — Authentication Method: ○ NONE ○ PAP ● CHAP

User name adsl@username

Password ••••••••

□ PPPoA Routed — Encapsulation VcMux; Global IP; Dynamic IP □ AutoDNS discovery □; Create as Default Route □

☑ PPPoE Routed — Global IP; Dynamic IP ☑ AutoDNS discovery ☑; Create as Default Route ☑; Access concentrator; Service name

DSL Configuration

● MULTI (AUTO) ○ ANSI (T1.413) ○ G.LITE ○ G.DMT

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Figure 15. PPP over Ethernet Routed Connection

If your Connection type is PPP over Ethernet Routed then choose the PPP radio button and check the `PPPoE Routed` option as shown above (*see Figure 15*).

You will also need to specify:

- the `Authentication Option`: PAP, CHAP or NONE
- the `Authentication Parameters:`
  - `Username`
  - `Password`
- the `Encapsulation` (*see discussion on Encaspulation on pag 27*)
- The `Global IP`. This may need to be manually set or may be automatically configured using the service provided by your service provider
  - If it is to be manually configured, then fill in the field `Global IP`
  - If it is to be automatically configured, then just check the `Dynamic IP` checkbox.
- The purpose of AutoDNS Discovery is to automatically obtain the address of a DNS server that the router can use.
- the `Create as Default Route` radio button, if checked, will create a default route via this connection.
- the `Access Concentrator` (optional): can be used to identify the PPPoE Server (Access Concentrator). It may be a combination of trademark, model, and serial ID information.

  Only specify this if instructed to by your service provider.
- the `Service Name` (optional): can be used to indicate the name of the service you connect to on the Access Concentrator.

  Only specify this if instructed by your service provider.

Chapter 3

LAN - USB

The main task in configuring LAN – USB interfaces is configuring the IP parameters. The following is an introduction to IP.

IP Protocol Introduction

IP protocols are widely used and available on nearly every hosts and PC systems. They provide a range of services including remote login, file transfer and Email.

The Internet

The Internet (with a capital "I") is the name given to the large, worldwide network of networks based on the original concepts of the ARPAnet. A large number of government, academic and commercial organisations are connected to the Internet, and use it to exchange traffic such as Email. The Internet uses the TCP/IP protocols for all routing. Recently the term Internet (with a lowercase "i") has also come to refer to any network (usually a wide area network) that utilises the Internet Protocol. The remainder of this chapter will concentrate on the latter definition, i.e. that of a generalised network which uses IP as the transport protocol.

The basic unit of data sent through an Internet is a packet or datagram. An IP network functions by moving packets between routers and/or hosts. A packet consists of a header followed by the data (*see Figure 16, Table 5*)**.** The header contains the information necessary to move the packet across the Internet. It must be able to cope with missing and duplicated packets as well as possible fragmentation (and reassembly) of the original packet.

Packets are sent using a connectionless transport mechanism. A connection is not maintained between the source and destination addresses; rather, the destination address is placed in the header and the packet is transmitted on a best effort basis. It is up to the intermediate systems (routers and gateways) to deliver the packet to the correct address, using the information in the header.

Successive packets may take different routes through the network to the destination. There is a strong analogy with the postal delivery system in which letters are placed in individually addressed envelopes and put into the system in the 'hope' that they will arrive. Like an Internet, the postal system is very reliable. In an Internet, higher layers (such as TCP and Telnet) are responsible for ensuring that packets are delivered in a reliable and sequenced way.

In contrast to a connectionless transport mechanism, a connection-oriented transport mechanism requires a connection to be maintained between the source and destination for as long as necessary to complete the exchange of packets between source and destination. X.25 is an example of a connection-oriented protocol. A good analogy to X.25 would be a telephone call, in which both parties verify that they are talking to the correct person before exchanging highly sequenced data (if they both talk at once then nothing intelligible results!), and the connection is maintained until both parties have finished talking. It is not hard to imagine the chaos if the telephone system delivered words in the wrong order.

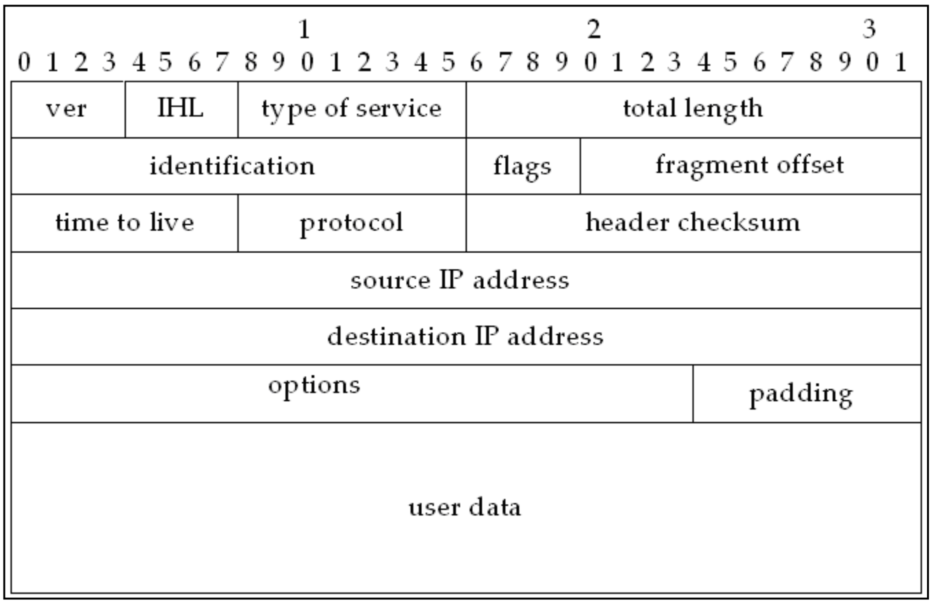


Figure 16. IP packet or datagram

Table 5: Functions of the fields in an IP datagram

Field	Function
Ver	The version of the IP protocol that created the datagram.
IHL	The length of the IP header in 32-bit words (the minimum value is 5).
Type of service	The quality of service (precedence, delay, throughput, and reliability) desired for the datagram.
Total length	The length of the datagram (both header and user data), in octets.
Identification	A 16-bit value assigned by the originator of the datagram, used during reassembly
Flags	Control bits indicating whether the datagram may be fragmented, and if so, whether other later fragments exist
Fragment offset	The offset in the original datagram of the data being carried in this datagram, for fragmented datagrams
Time to live	The time in seconds the datagram is allowed to remain in the Internet system
Protocol	The high level protocol used to create the message (analogous to the type field in an Ethernet packet)
Header checksum	A checksum of the header
Source IP address	32-bit IP address of the sender
Destination IP address	32-bit IP address of the recipient
Options	An optional field primarily used for network testing or Debugging.
Padding	All bits set to zero—used to pad the datagram header to a length that is a multiple of 32 bits.
User data	The actual data being sent.

Addressing

Internet addresses are fundamental to the operation of the TCP/IP Internet. Each packet must contain an Internet address to determine where to send the packet. Most packets also require a source address so that the sender of the packet is known. Addresses are 32-bit quantities that are logically divided into fields. They must not be confused with physical addresses (such as an Ethernet address); they serve only to address Internet Protocol packets. Addresses are organised into five classes (Table 6).

Table 6: Internet Protocol address classes and limits on numbers of networks and hosts.

Class	Maximum number of possible networks	Maximum number of hosts per network
A	127	*16,777,216*
B	16,384	*65,536*
C	2,097,152	*255*
D	Reserved Class	
E	Reserved Class	

Each class differs in the number of bits assigned to the host and network portions of the address (*see Figure 17*).

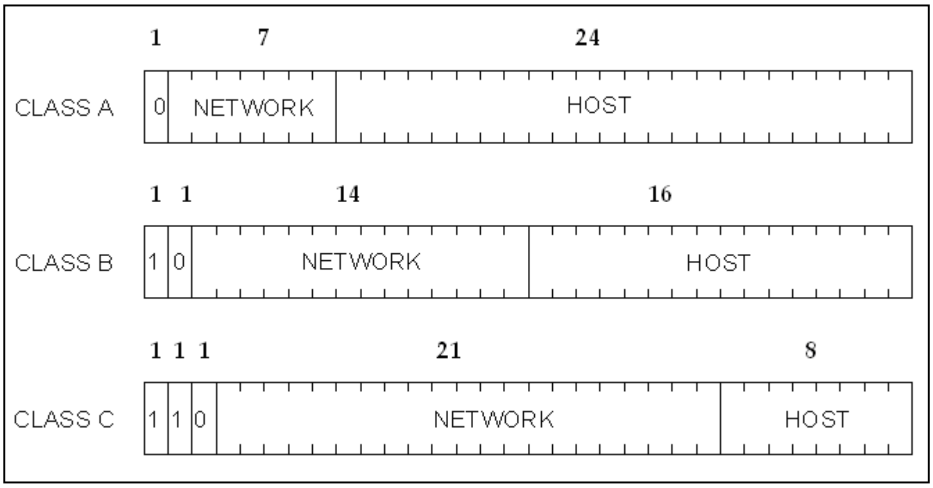


Figure 17. Subdivision of the 32 bits of an Internet address

The addressing scheme is designed to allow routers to efficiently extract the host and network portions of an address. In general a router is only interested in the network portion of an address.

Class A sets the Most Significant Bit (MSB) to 0 and allocates the next 7 bits to define the network and the remaining 24 bits to define the host. Class B sets the two MSBs to 10 and allocates the next 14 bits to designate the network while the remaining 16 refer to the host. Class C sets the three MSBs to '110' and allocates the next 21 bits to designate the network while the remaining 8 are left to the user to assign as host or subnet numbers.

The term host refers to any attached device on a subnet, including PCs, mainframes and routers. Most hosts are connected to only one network. In other words they have a single IP address. Routers are connected to more than one network and can have multiple IP addresses. The IP address is expressed in dotted decimal notation by taking the 32 binary bits and forming 4 groups of 8 bits, each separated by a dot.

For example:

`10.4.8.2` is a class A address
`10` is the DDN assigned network number
`.4.8` are (possibly) user assigned subnet numbers
`.2` is the user assigned host number

`172.16.9.190` is a class B address

`172.16` is the DDN assigned network number
`.9` is the user assigned subnet number
`.190` is the user assigned host number

The value 0.0.0.0 is used to define the default address, while a value of all ones in any host portion (i.e. 255) is reserved as the broadcast address. Some older versions of UNIX use a broadcast value of all zeros, therefore both the value '0' and the value '255' are reserved within any user assigned host portion. The address 172.16.0.0 refers to any host (not every host) on any subnet within the class B address 172.16. Similarly 172.16.9.0 refers to any host on subnet 9, whereas 172.16.9.255 is a packet addressed to every host on subnet 9. The router uses this terminology to indicate where packets are to be sent.

An address with '0' in the host portion refers to 'this particular host' while an address with '0' in the network portion refers to 'this particular network'. As mentioned above a value of all '1' (255) is a broadcast. To reduce loading, IP consciously tries to limit broadcasts to the smallest possible set of hosts, hence most broadcasts are 'directed'. For example 172.16.56.255 is a broadcast to subnet 56 of network 172.16. A major problem with the IP type of addressing is that it defines connections not hosts. A particular address, although it is unique, defines a host by its connection to a particular network. Therefore if the host is moved to another network the address must also change. The situation is analogous to the postal system. A related problem can occur when an organisation which has a class C address finds that they need to upgrade to class B. This involves a total change of every address for all hosts and routers. Thus the addressing system is not scalable.

Subnets

Related to the two issues discussed above, the rapid growth of the Internet has meant a proliferation in the number of addresses which must be handled by the core routers. More addresses means more loading and tends to slow the system down. This is overcome by minimising the number of network addresses by sharing the same IP prefix (the assigned network number) with multiple physical networks. Generally these would all be within the same organisation, although this is not a requirement.

A subnet is formed by taking the host portion of the assigned address and dividing it into two parts. The first part is the 'set of subnets' while the second refers to the hosts on each subnet. For example the DDN may assign a class B address as 172.16.0.0. The system manager would then assign the lower two octets in some way which makes sense for this particular network. A common method for class B is simply to use the higher octet to refer to the subnet. Thus there are 254 subnets (0 and 255 are reserved) each with 254 hosts. These subnets need not to be physically on the same media. Generally they would be allocated geographically with subnet 2 being one site, subnet 3 another and so on. Some sites may have a requirement for multiple subnets on the same LAN.

This could be to increase the number of hosts or simply to make administration easier. In this case it is normal (but not required) that the subnets be assigned contiguously for this site. This makes the allocation of a subnet mask easier.

This mask is needed by the routers to ascertain which subnets are available at each site. Bits in the mask are set to '1' if the router is to treat the corresponding bit in the IP address as belonging to the network portion or set to '0' if it belongs to the host portion. This allows a simple bit-wise logical AND to determine if the address should be forwarded or not. Although the standard does not require that the subnet mask must select contiguous bits, it is normal practice to do so. Otherwise can make the allocation of numbers rather difficult and prone to errors. Some example masks are:

11111111.11111111.11111111.00000000 = 255.255.255.0
<----network--------> <subnet> <-host->

This would give 254 subnets on a class B network, each with 254 hosts.

11111111.11111111.11111111.11110000 = 255.255.255.240
<------network-----> <----subnet----><host>

This would give 4094 subnets on a class B network, each with 14 hosts or, 14 subnets on a class C network each with 14 hosts.

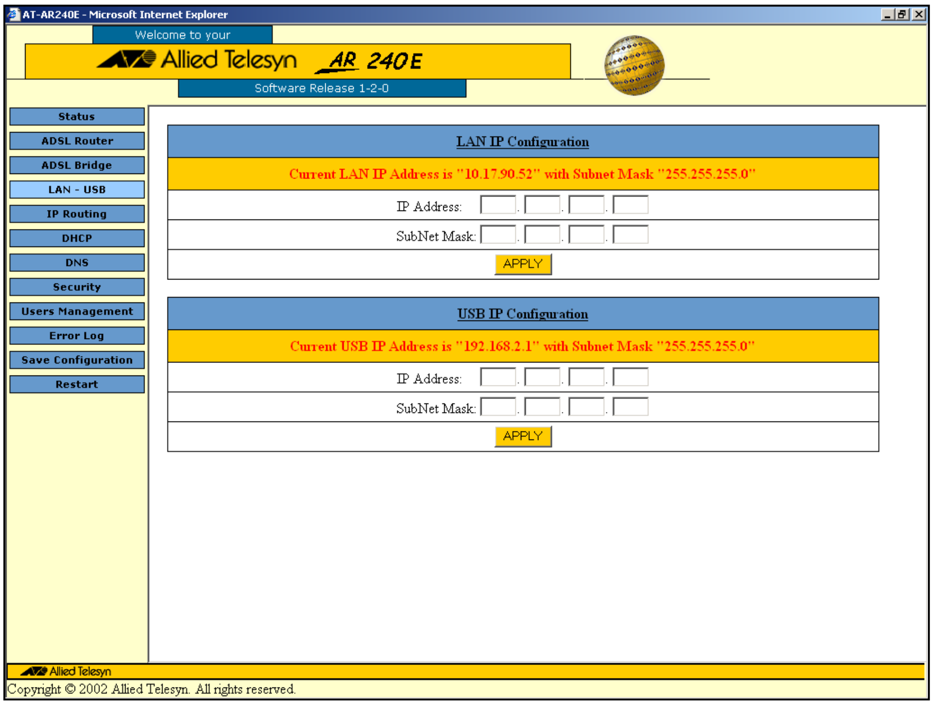
Changing the AT-AR240E LAN - USB IP address

By default, the LAN IP address is set at 192.168.1.1 for users connected to the Ethernet Port of their Router and 192.168.2.1 for users connected to the USB Port of their Router.
To change the default LAN port IP address:

i) Enter the new address in the IP address and Subnet mask fields in the `Default LAN IP Configuration` and click Apply.
ii) Allow some time (approximately 1 minute) for your Router to complete the change of IP address.

The same operation should be followed in order to change the USB IP Configuration.

If a different LAN IP address (as determined by your System Administrator) is entered, you will be prompted with a dialog box, indicating the need to change your system's (Ethernet Card) IP Address. Click OK at the prompts and proceed to change your system's IP Address.



LAN IP Configuration

Current LAN IP Address is "10.17.90.52" with Subnet Mask "255.255.255.0"

IP Address: ___ . ___ . ___ . ___

SubNet Mask: ___ . ___ . ___ . ___

USB IP Configuration

Current USB IP Address is "192.168.2.1" with Subnet Mask "255.255.255.0"

IP Address: ___ . ___ . ___ . ___

SubNet Mask: ___ . ___ . ___ . ___

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Figure 18. How to change the LAN/USB IP Address

Upon changing the LAN or USB IP settings, the DHCP server related settings are also automatically updated to remain consistent with the new configuration.

IP Routing

The IP routing section allows the AT-AR204E Administrator to create new static routes (*see Figure 19*). In order to create a new static route the following information are required:

`Destination Network ID`: the network Address of the destination subnet (0.0.0.0 is the default route that will be used if none of the specific routes defined matches the destination IP).

`Destination subnet mask`: the subnet mask of network subnet (for the case of the default route the subnet mask is 0.0.0.0).

`Input Specific Gateway`: the IP Address of the gateway via which packets would leave the local network in order to reach the destination subnet.
`Choose an Interface`: an already created interface can be selected as the interface via which packets for the destination subnet would leave the router.

`Cost:` Enter the value for cost. It refers to the number of hops counted as the cost of the route, which may affect the choice of route when the route is competing with routes acquired from RIP. (But note that using a mixture of RIP and static routing is not advised).

NOTE: If you are creating a route that is via a WAN interface (ie a route directed out over the ADSL) then you should specify the Interface for the route, rather than specifying the gateway address. This is particularly so in the case that the IP address on the WAN interface is dynamically assigned

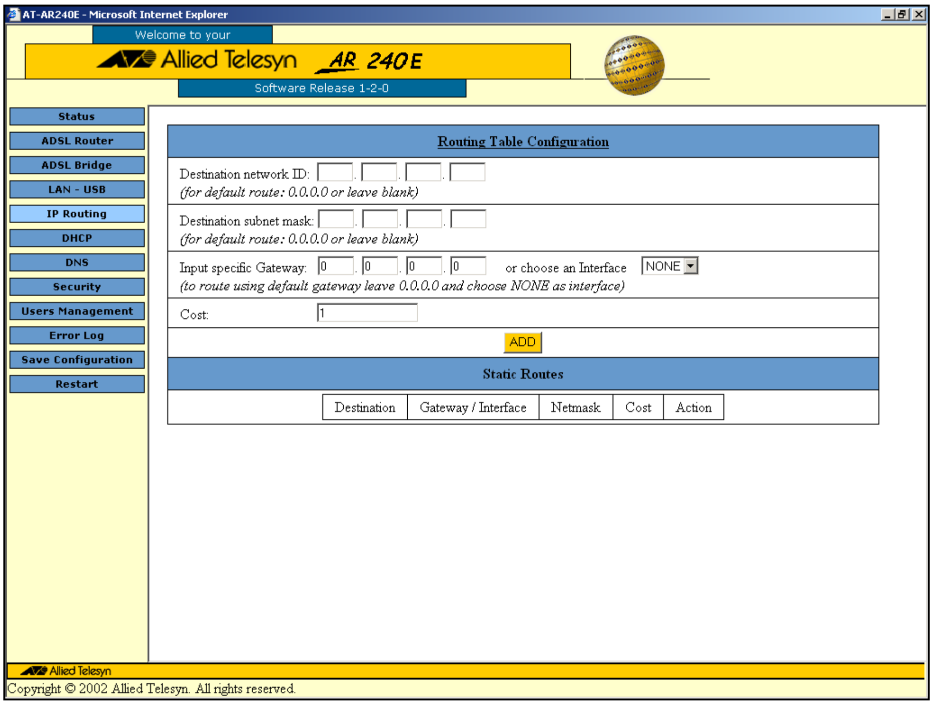
Conversely, if you are creating a route that is via the LAN interface, then you MUST specify the gateway address for the route. It is important that the gateway address you specify is that IP address of a the other router on LAN via which data will be sent to the destination subnet. The gateway address is NOT the IP address on the LAN interface of the AT-AR240E itself.

When you have entered the required information, click `ADD`, and the route will be created. The lower part of the page diplays previously created routes. Clicking on the `DELETE` button beside a given route will delete it.

☞ *The Timeout value, which specifies the length of time before the route entry times out is set to 0 by default. This means the route entries will never timeout.*

☞ *If the* `Input Specific Gateway` *field has the default value* `("0.0.0.0")` *AND the interface selection list box shows* `NONE` *THEN the route under creation will use the default gateway. This happens under the condition that a default gateway has been already created.*

☞ *If an invalid route is created, then entering the IP routing page a warning message will inform that the wrong route will be deleted.*



Routing Table Configuration

Destination network ID: ___ . ___ . ___ . ___
(for default route: 0.0.0.0 or leave blank)

Destination subnet mask: ___ . ___ . ___ . ___
(for default route: 0.0.0.0 or leave blank)

Input specific Gateway: 0 . 0 . 0 . 0 or choose an Interface NONE
(to route using default gateway leave 0.0.0.0 and choose NONE as interface)

Cost: 1

Static Routes

Destination	Gateway / Interface	Netmask	Cost	Action

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Figure 19. How to add a new Static Route

Chapter 4

DHCP

The Dynamic Host Configuration Protocol

The Dynamic Host Configuration Protocol (DHCP) is defined in RFC 1541 and provides a mechanism for passing configuration information to hosts on a TCP/IP network. DHCP is based on the Bootstrap Protocol (BOOTP) defined in RFC 1542, but adds automatic allocation of reusable network addresses and additional configuration options. DHCP is based on a client–server model, where the server is the host that allocates network addresses and initialization parameters, and the client is the host that requests these parameters from the server.

There are a number of parameters that a DHCP server can supply to clients in addition to assigning IP addresses. They can supply addresses of DNS server, WINS Server, Cookie server etc… Also, they can supply the gateway address for the LAN.

DHCP supports three mechanisms for IP address allocation. In the *automatic allocation* mechanism, DHCP assigns a permanent IP address to a host. In the *dynamic allocation* mechanism, DHCP assigns an IP address to a host for a limited period of time, or until the host explicitly relinquishes the address. In the *manual allocation* mechanism, the network administrator assigns a host's IP address, and DHCP is used simply to convey the assigned address to the host. A particular network will use one or more of these mechanisms, depending on the policies of the network administrator.

Dynamic allocation is the only one of the three mechanisms that allows automatic reuse of an address that is no longer needed by the host to which it was assigned. Dynamic allocation is particularly useful for assigning an address to a host that will be connected to the network only temporarily, or for sharing a limited pool of IP addresses among a group of hosts that do not need permanent IP addresses. Dynamic allocation may also be a good choice for assigning an IP address to a new host being permanently connected to a network where IP addresses are sufficiently scarce that it is important to reclaim them when old hosts are retired.

The DHCP server facility in the AT-AR240E only supports dynamic allocation.

The AT-AR240E's support for DHCP

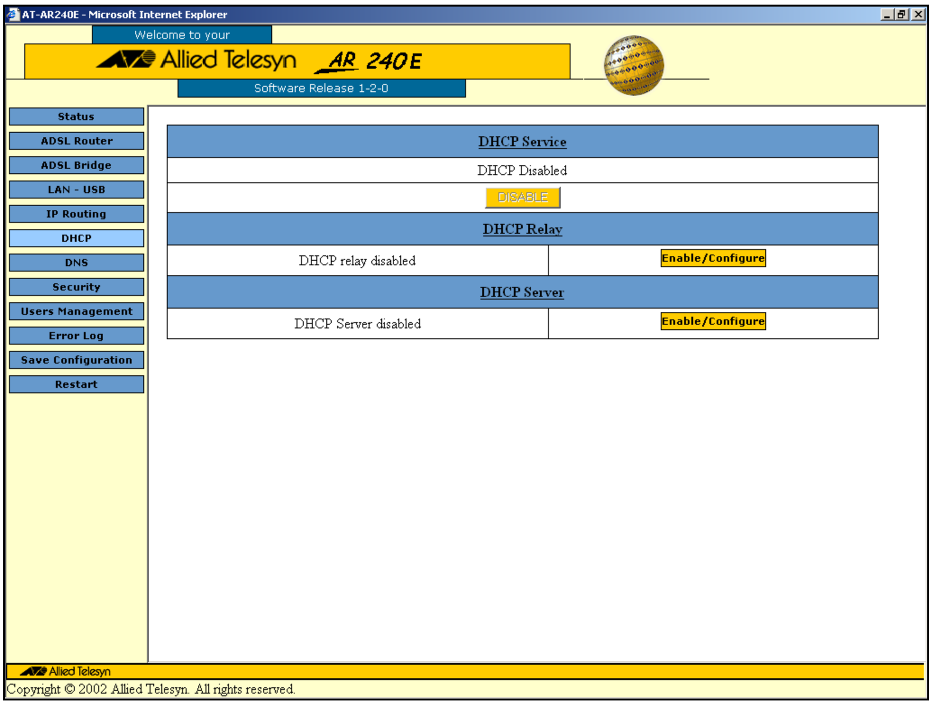
The AT-AR240E can handle DHCP packets in one of three mutually exclusive ways:

1. Ignore the packets – `DHCP relay` disabled and `Server` disabled
   or
2. Relay the DHCP packets on to some other device that is known to be a DHCP server – `DHCP Relay` enabled, `DHCP Server` Disabled
   or
3. Act as a DHCP server itself - `DHCP Relay` disabled, `DHCP Server` enabled

Obviously, no particular configuration is needed in the case that DHCP packets are ignored. The rest of this chapter is devoted to describing the details of configuring the DHCP Relay and DHCP Server option.
The AR240E default setting is DHCP Server enabled.

DHCP Relay

Clicking on the DHCP item in the Web interface Side Menu will present the DHCP Service page illustrated in Figure 20.



DHCP Service

DHCP Disabled

DHCP Relay

DHCP relay disabled

DHCP Server

DHCP Server disabled

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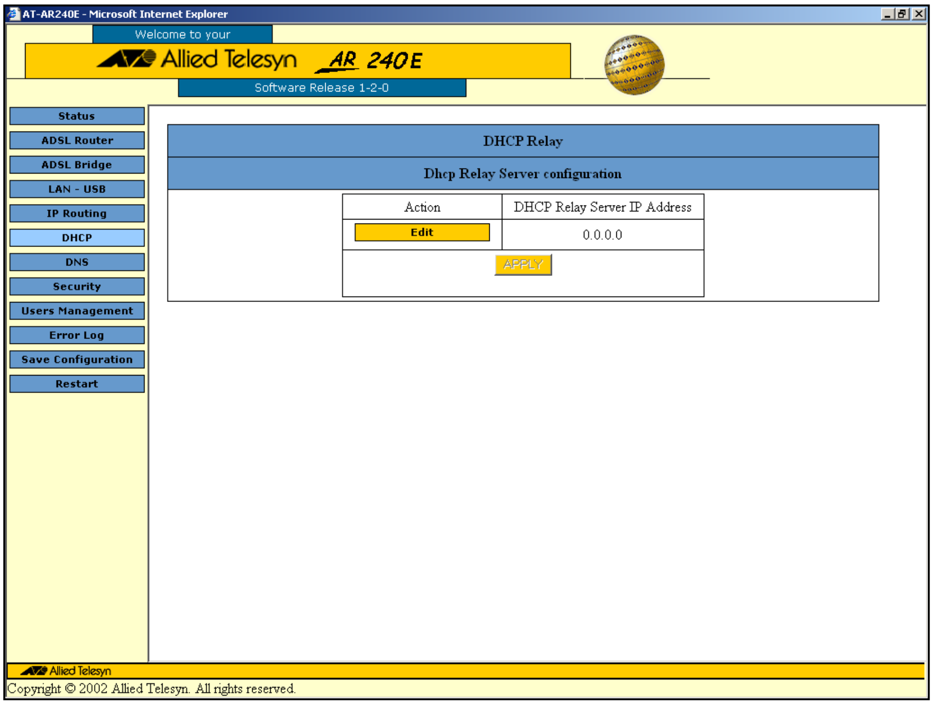
Figure 20. DHCP service web page

To configure the router as a DHCP relay, click on the `Enable/Configure` button in the "`DHCP Relay`" field of the DHCP Service page. The DHCP Relay page, illustrated in Figure 21, will be presented.



DHCP Relay

Dhcp Relay Server configuration

Action	DHCP Relay Server IP Address
Edit	0.0.0.0

APPLY

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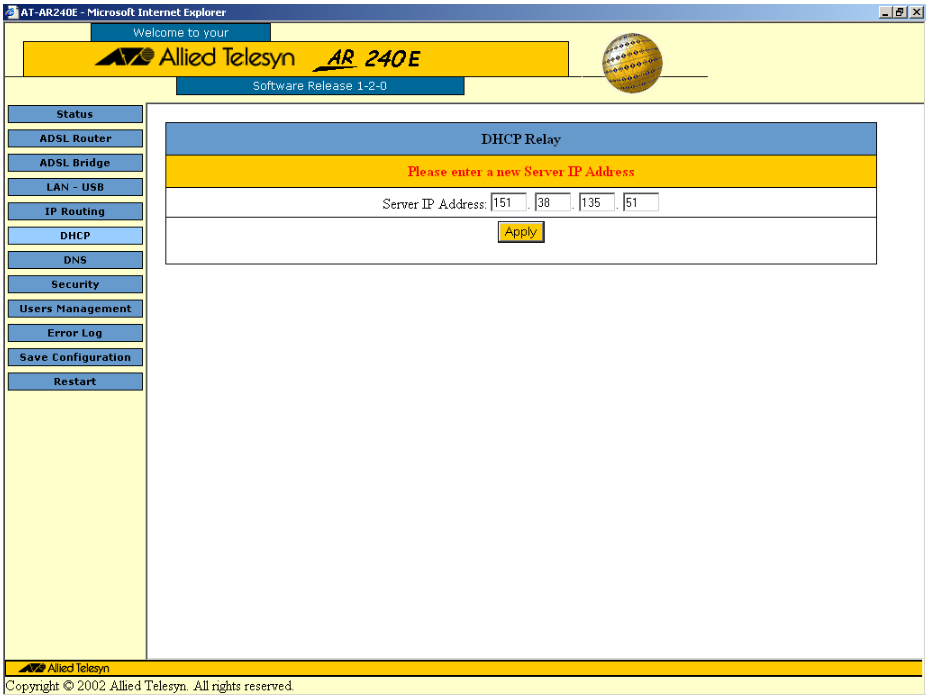
Figure 21. DHCP relay

Click on `EDIT`, and the DHCP Relay Configuration page, illustrated in Figure 22, will be presented.

This page has only one configurable item. Namely the address of the DHCP server to which the router will relay DHCP packets. For example, in order to set a new configuration for relaying the DHCP requests to the address `151.38.135.51`:

- insert the IP address `151.38.135.51` in the `Server IP address` field
- click on `APPLY`



DHCP Relay

Please enter a new Server IP Address

Server IP Address: 151 . 38 . 135 . 51

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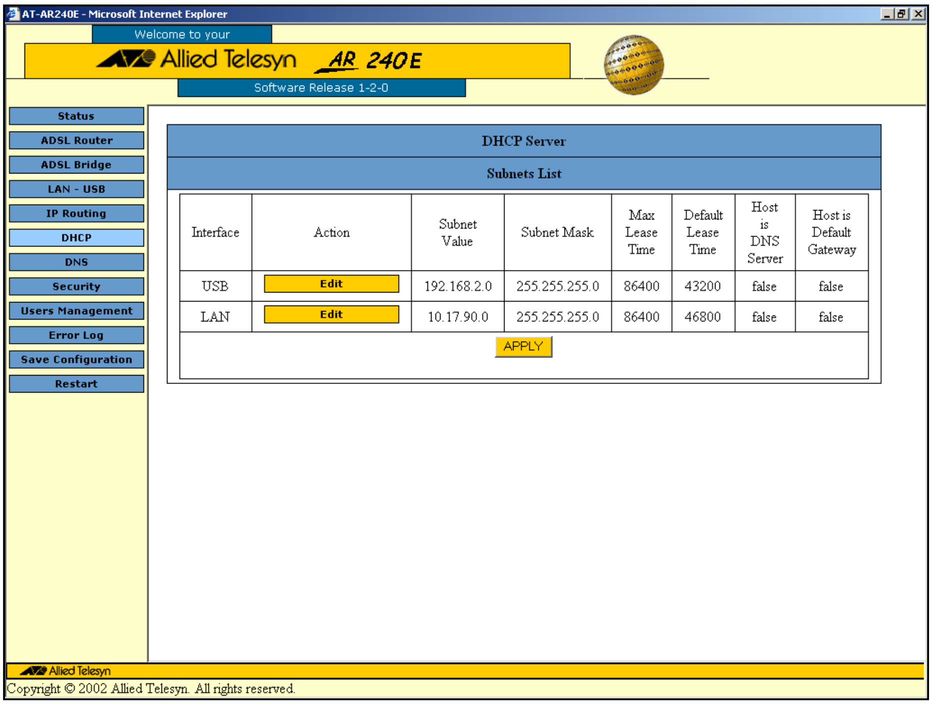
Figure 22. DHCP relay setting

DHCP Server

The AT-AR240E DHCP Server only supports dynamic address allocation. It is not possible to configure static IP assignments. The server can supply up to 25 clients with two parameters in addition to an assigned address. The parameters are DNS address and Gateway address.

To configure the router as a DHCP Server, click on the enable/configure button in the DHCP Server field of the DHCP Service page. The DHCP Server page illustrated in Figure 23 will appear.



DHCP Server

Subnets List

Interface	Action	Subnet Value	Subnet Mask	Max Lease Time	Default Lease Time	Host is DNS Server	Host is Default Gateway
USB	Edit	192.168.2.0	255.255.255.0	86400	43200	false	false
LAN	Edit	10.17.90.0	255.255.255.0	86400	46800	false	false

APPLY

Figure 23. DHCP server

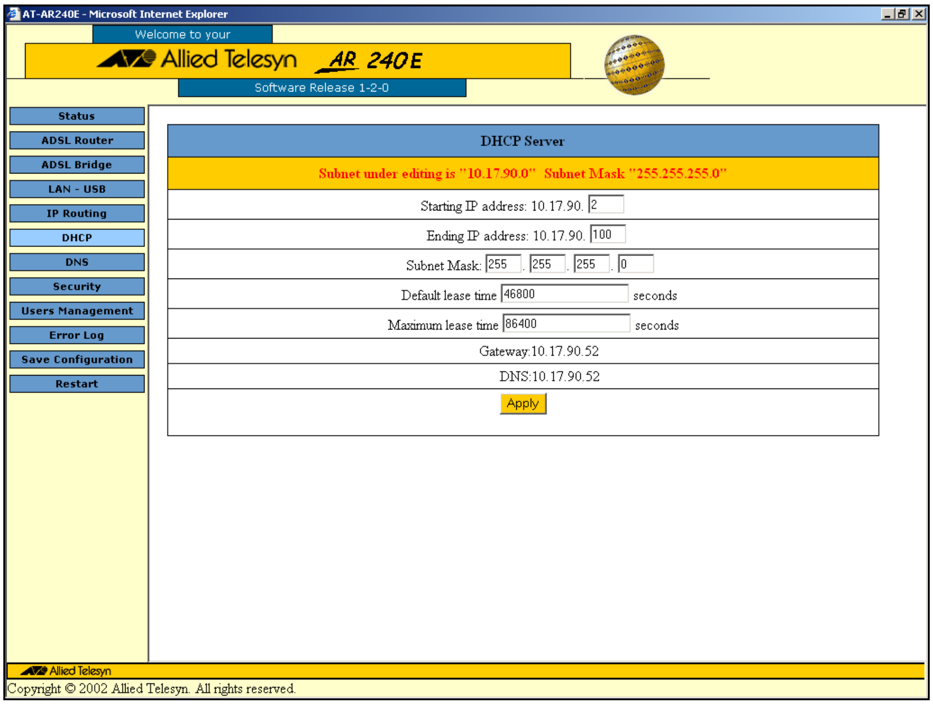
In order to change the DHCP server settings, click on the related `Enable/Configure` button. A web page as in Figure 24 will appear.

It is possible to modify the setting of the DHCP server both on the LAN and on the USB interface.

To modify the DHCP server settings, click on EDIT. The following parameters are required:

- `Starting IP address`: refers to the first IP address of the range available to be assigned to requesting PC's.
- `Ending IP address`: refers to the last IP address of the range available to be assigned to requesting PC's..
- `Subnet Mask`: to specify the subnet mask that will be assigned to the clients
- `Default lease time:` to specify the default length of time a DHCP client (your PCs) can use an assigned IP address before it must renew its configuration with the DHCP server (Router).
- `Maximum lease time:` to specify the maximum length of time a DHCP client (your PCs) can use an assigned IP address before it must renew its configuration with the DHCP server (Router)
- `DNS:` this is the DNS address that will be sent, along with an assigned IP address, to the requesting PC's.
  The value displayed is the DNS server address that is configured on the DNS configuration page (*see chapter 5*).
- `Gateway`: this is the gateway address that will be sent to requesting PC's. The value cannot be configured on this page.

The value displayed is the router's LAN IP address. I.e. it is assumed that PC's that are sending DHCP requests to the router will be using the router as their gateway.



DHCP Server

Subnet under editing is "10.17.90.0" Subnet Mask "255.255.255.0"

Starting IP address: 10.17.90. 2

Ending IP address: 10.17.90. 100

Subnet Mask: 255 . 255 . 255 . 0

Default lease time 46800 seconds

Maximum lease time 86400 seconds

Gateway:10.17.90.52

DNS:10.17.90.52

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Figure 24. DHCP server settings

Chapter 5

DNS

DNS introduction

DNS is an abbreviation for Domain Name System, a system for naming computers and network services that is organized into a hierarchy of domains. DNS naming is used in TCP/IP networks, such as the Internet, to locate computers and services through user-friendly names. When a user enters a DNS name in an application, DNS services can resolve the name to other information associated with the name, such as an IP address.

For example, most users prefer a friendly name such as example.alliedtelesyn.com to locate a computer such as a mail or Web server on a network. A friendly name can be easier to learn and remember. However, computers communicate over a network by using numeric addresses. To make use of network resources easier, name services such as DNS provide a way to map the user-friendly name for a computer or service to its numeric address. If you have ever used a Web browser, you have used DNS.

The following graphic shows a basic use of DNS, which is finding the IP address of a computer based on its name.

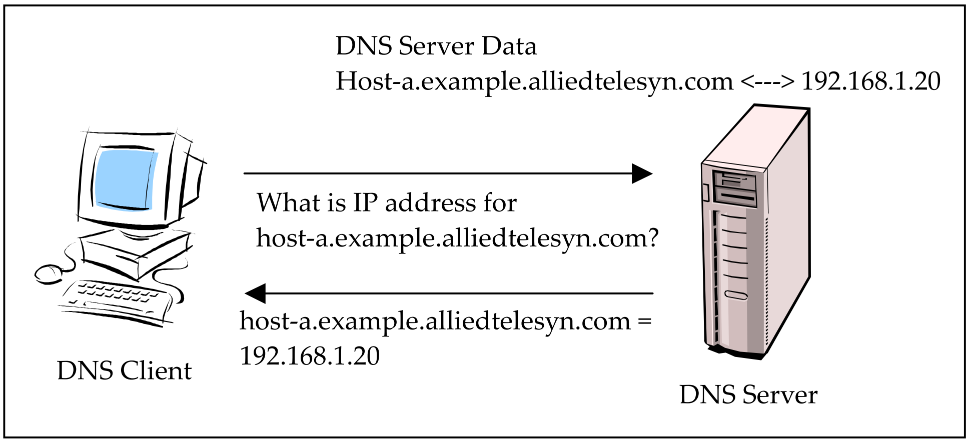

DNS Server Data
Host-a.example.alliedtelesyn.com <---> 192.168.1.20
What is IP address for
host-a.example.alliedtelesyn.com?
host-a.example.alliedtelesyn.com =
192.168.1.20
DNS Client
DNS Server

Figure 25. Domain Name System

In this example, a client computer queries a server, asking for the IP address of a computer configured to use host-a.example.alliedtelesyn.com as its DNS domain name. Because the server is able to answer the query based on its local database, it replies with an answer containing the requested information, which is a host (A) resource record that contains the IP address information for host-a.example.alliedtelesyn.com. The example shows a simple DNS query between a single client and server. In practice, DNS queries can be more involved than this and include additional steps not shown here.

DNS Relay

The AR240E can act as a DNS relay. So, DNS packets which arrive at the router, addressed to the router, will be relayed on to a known DNS Server. So, the devices on the LAN can treat the router as though it were the DNS Server. Only the router needs to know the address of the real DNS Server.
To enable or disable this service, click the `Enable/Disable` radio button in the DNS Relay field of the page illustrated in Figure 26.
If the relay is enabled, the "`manual setting of server address`" field can be filled with the address of the DNS server to which the requests will be relayed.
Using the Web interface it is possible to enable a DNS relay service.

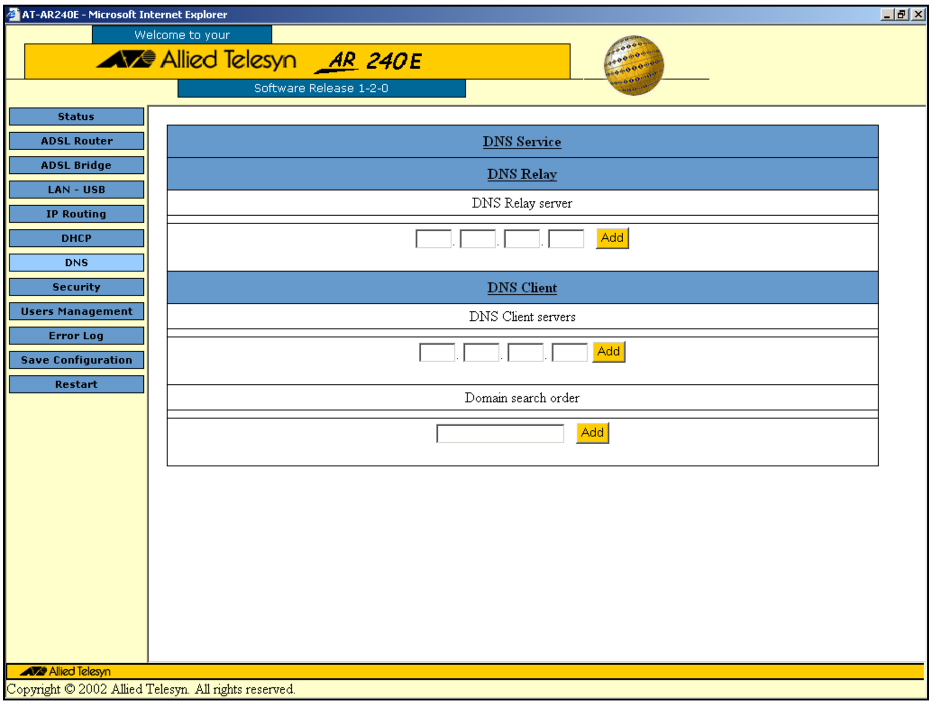


Figure 26. DNS relay settings

DNS Client

The AT-AR240E is provided with an internal DNS client. It is possible to add DNS server addresses that will be used by the router ONLY for its own lookups. It is possible also to define a list of domain names using the "Domain Search Order" field. This list will be used by the router ONLY for its own lookups.

It is important to understand that the items configured in the DNS client section will NOT be used by the DNS relay. So, for example, the domain names in the “Domain Search Order” will NOT be appended to domain name requests received by the relay from hosts on the LAN.

Chapter 6

Security

Introduction

This chapter describes the AT-AR240E router's built-in security facilities, and how to configure and monitor them.

The Internet is a network that allows access to vast amounts of information and potential customers. However, the Internet is not controlled and certain individuals use it destructively. These individuals attack other users' computer systems for entertainment and/or profit.

The security system is designed to allow safe access to the Internet by enforcing a set of access rules between the various interfaces of the product. To configure these rules at least two interfaces have to be defined — one interface is attached to the public network (e.g., the Internet), and the other interface is attached to an internal private network (intranet) that requires protection. The security prevents unrestricted access to the private network and protects the computer systems from attack.

The security system provides a single link between the private network and the public network, it is also uniquely positioned to provide a single point where all traffic entering and leaving the private network can be logged and monitored. This information is useful for providing a security audit trail.
Currently, two main security technologies are recognized that are briefly explained in the following.

Application Gateway

This is the traditional approach used to build a firewall, where every connection between two networks is made via an application program (called a *proxy*) specific for that protocol. A session from the private network is terminated by the proxy, which then creates another separate session to the end destination.

Typically, a proxy is designed with a detailed knowledge of how the protocol works and what is allowed or not. This approach is very CPU intensive and very restrictive. Only protocols that have specific proxies configured are allowed through the security system; all other traffic is rejected. In practice most third-party proxies are transparent proxies, which pass all traffic between the two sessions without regard to the data.

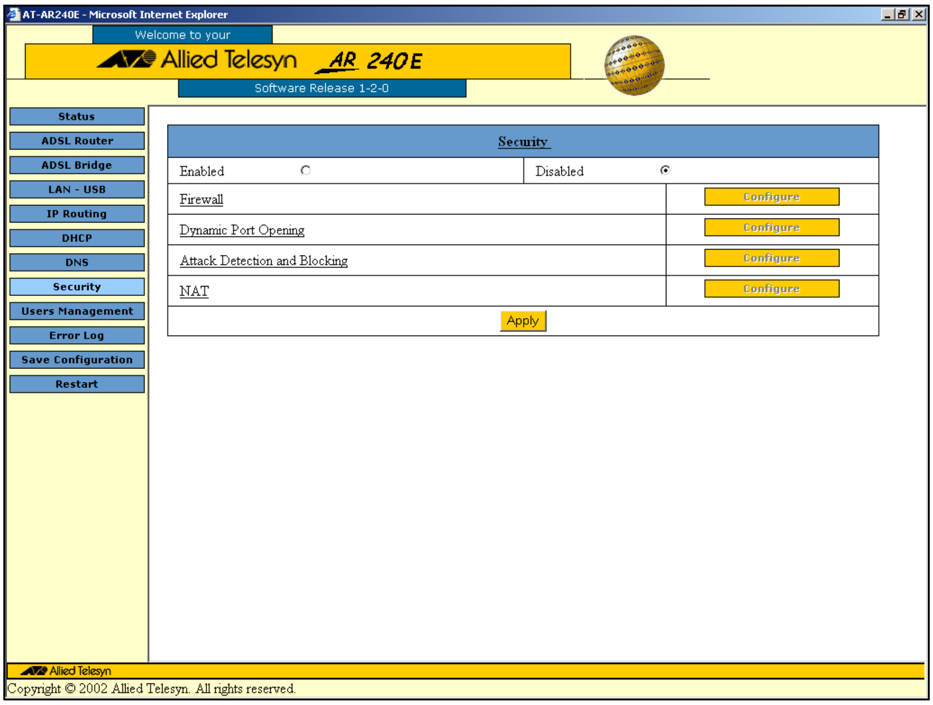
Stateful Inspection

A more recent approach to security design uses a method called *"stateful inspectio*n". Stateful inspection is also referred to as *dynamic packet filtering*or *context-based access control* (CBAC).

In this technology, an inspection module understands data in packets from the network layer (IP headers) up to the application layer. The inspection module checks every packet passing through the security system and makes access decisions based on the source, destination and service requested. The term *stateful* refers to the security system's ability to remember the status of a flow. For example, whether a packet from the public Internet is returning traffic for a flow originated from the private intranet. The TCP state of TCP flows is also monitored, allowing inappropriate traffic to be discarded. The benefit of this approach is that stateful inspection security systems are generally faster, less demanding on hardware, and more adaptive to new Internet applications.
The AT-AR204E router's security system implementation has the following features:

- Dynamic packet filtering (stateful inspection) technology.
- Application of dynamic filtering to traffic flows, using the base rule that all access from the outside (i.e., public interfaces) is denied unless specifically permitted and all access from the inside (i.e., private interfaces) is allowed unless specifically denied.
- The firewall will open only the required ports for the duration of a user session.
- The firewall can be configured to limit internal access to the public network based on a policy setting.

Figure 27 shows the main web page for security configuration.



Security	
Enabled ○	Disabled ●
Firewall	Configure
Dynamic Port Opening	Configure
Attack Detection and Blocking	Configure
NAT	Configure
Apply	

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Figure 27. Security configuration web page

The security features in the AT-AR240E are divided into four areas:

Firewall

This covers the creation of policies and filtering rules.

Dynamic Port Opening

This is a companion feature to the filtering rules. There are a number of Internet applications that require secondary ports to be open in order for a session to operate. For example, an FTP control session operates on port 21, but FTP uses port 20 as a secondary port for the data transfer process. The more ports that are open, the greater the security risk. So, the “Dynamic Port Opening” service enables you to designate certain secondary ports that will only be opened when there is an active session on their associated primary port.

Because FTP is such a very common application, the dynamic port opening for FTP is enabled in the software by default, and does not have to be configured by the user.

Attack Detection and Blocking

The purpose of this feature is to look for traffic patterns that correspond to certain known types of attack: port scans, host scans, Ping floods etc ...

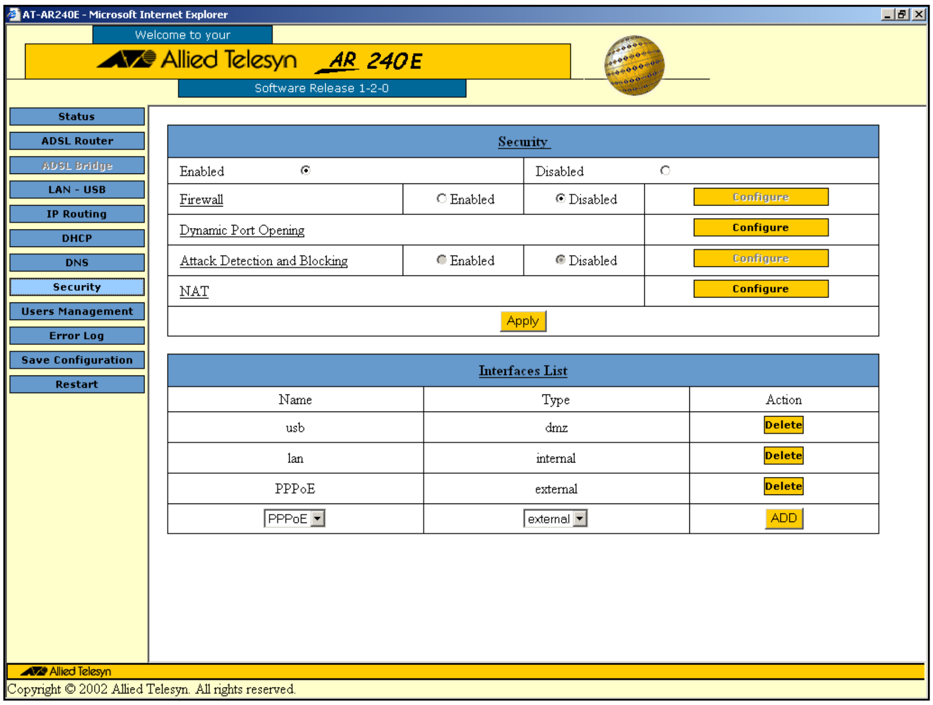
Upon detecting such a traffic pattern, the router can take certain configurable actions.

NAT

The AT-AR240E implements Port-based network Address Translation. The NAT can be configured to enable incoming sessions to particular private hosts.
We will now examine the details of configuring these four features.

Security interfaces

The first step to configure any of the security features is to enable the security module. This is done by clicking the "Enabled" radio button on the Security page. Then click APPLY.
The next step is to associate some interfaces with the Security module.
Once the security module has been enabled, as described above, the security page presents "Interfaces List" fields as illustrated in Figure 28. These fields are used for associating interfaces to the security module. Each line contains two drop-down menus.



Security			
Enabled ●		Disabled ○	
Firewall	○ Enabled	● Disabled	Configure
Dynamic Port Opening			Configure
Attack Detection and Blocking	○ Enabled	● Disabled	Configure
NAT			Configure
	Apply		

Interfaces List		
Name	Type	Action
usb	dmz	Delete
lan	internal	Delete
PPPoE	external	Delete
PPPoE ▾	external ▾	ADD

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Figure 28. Interfaces List

The "name" field lists of all the IP interfaces currently created on the router. The "Type" field contains a list of all the roles that these interfaces can take within the security module. The choices are:

- `Internal`: an interface to a private network. Hosts on a private network are considered to be benign, but in need of protection from incoming attacks.
- `External`: an interface to on public network (typically the Internet) which may contain hosts which will launch attacks.
- `Dmz`: similar to an internal interface, but using by default a lower security level.

Once an external interface is defined (e.g. PPPoE) it is necessary to define both the LAN and the USB interfaces in order to enable the NAT services between pairs of interfaces.

Firewall

Clicking on the Firewall Configure button, a web page as in Figure 29 will appear. The firewall service can be configured using three pre-defined levels that are:

1. LOW: setting this level all output traffic is allowed; incoming traffic is blocked only for http, ftp, telnet, smtp, pop3, nntp and icmp. To enable this security level:

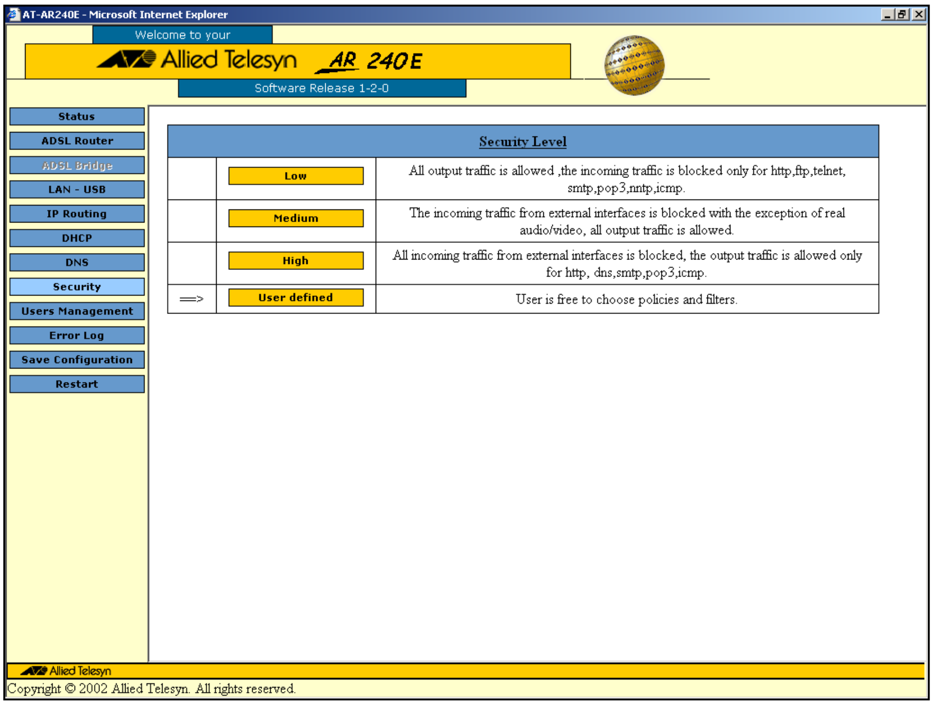
   - click on `LOW`
   - a page as in Figure 30 will appear where the GREEN rectangles refer to allowed traffic, and the RED rectangles refer to blocked traffic
   - Click on the `APPLY` button

2. MEDIUM: setting this level, incoming traffic from external interfaces is blocked with the exception of real audio/video; all output traffic is allowed. To enable this security level:

   - click on `Medium`
   - a page as in Figure 31 will appear where the GREEN rectangles refer to allowed traffic, and the RED rectangles refer to blocked traffic
   - Click on the `APPLY` button

3. HIGH: setting this level all incoming traffic from external interfaces is blocked; output traffic is allowed only for http, dns, sntp, pop3 and icmp. To enable this security level:

   - click on `High`
   - a page as in Figure 32 will appear where the GREEN rectangles refer to allowed traffic, and the RED rectangles refer to blocked traffic
   - Click on the `APPLY` button



Security Level

	Low	All output traffic is allowed ,the incoming traffic is blocked only for http,ftp,telnet, smtp,pop3,nntp,icmp.
	Medium	The incoming traffic from external interfaces is blocked with the exception of real audio/video, all output traffic is allowed.
	High	All incoming traffic from external interfaces is blocked, the output traffic is allowed only for http, dns,smtp,pop3,icmp.
==>	User defined	User is free to choose policies and filters.

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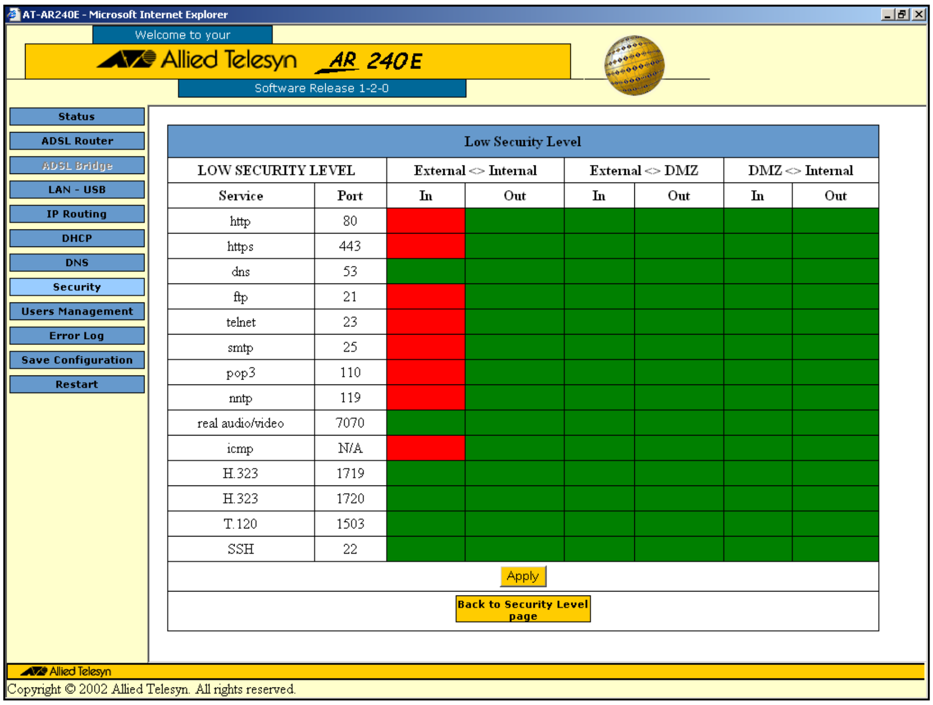
Figure 29. Security level



Low Security Level

LOW SECURITY LEVEL		External <> Internal		External <> DMZ		DMZ <> Internal	
Service	Port	In	Out	In	Out	In	Out
http	80	🟥	🟩	🟩	🟩	🟩	🟩
https	443	🟥	🟩	🟩	🟩	🟩	🟩
dns	53	🟩	🟩	🟩	🟩	🟩	🟩
ftp	21	🟥	🟩	🟩	🟩	🟩	🟩
telnet	23	🟥	🟩	🟩	🟩	🟩	🟩
smtp	25	🟥	🟩	🟩	🟩	🟩	🟩
pop3	110	🟥	🟩	🟩	🟩	🟩	🟩
nntp	119	🟥	🟩	🟩	🟩	🟩	🟩
real audio/video	7070	🟩	🟩	🟩	🟩	🟩	🟩
icmp	N/A	🟥	🟩	🟩	🟩	🟩	🟩
H.323	1719	🟩	🟩	🟩	🟩	🟩	🟩
H.323	1720	🟩	🟩	🟩	🟩	🟩	🟩
T.120	1503	🟩	🟩	🟩	🟩	🟩	🟩
SSH	22	🟩	🟩	🟩	🟩	🟩	🟩

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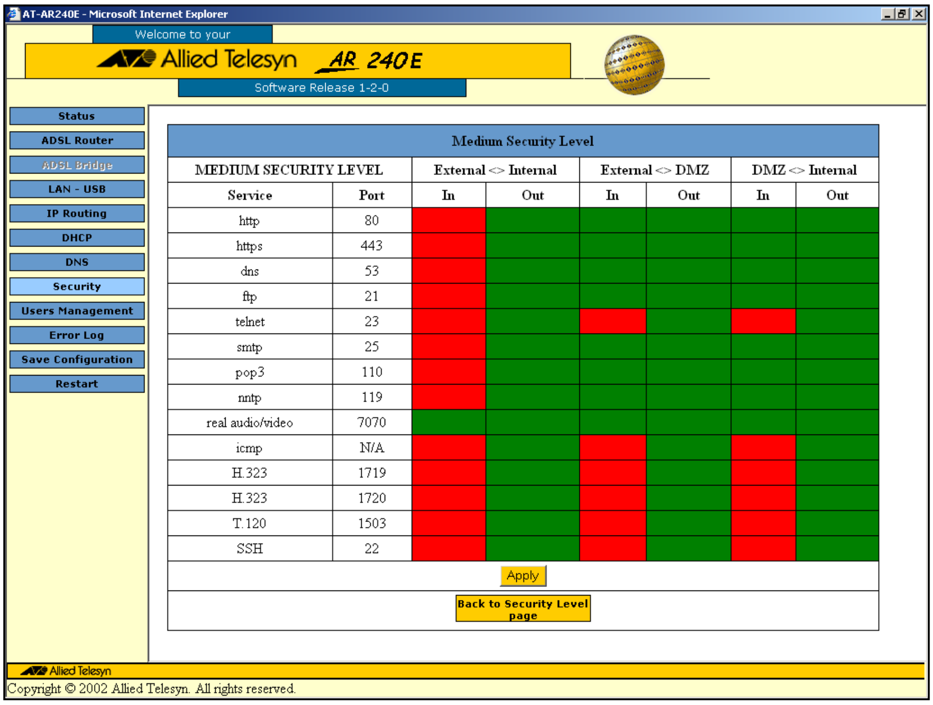
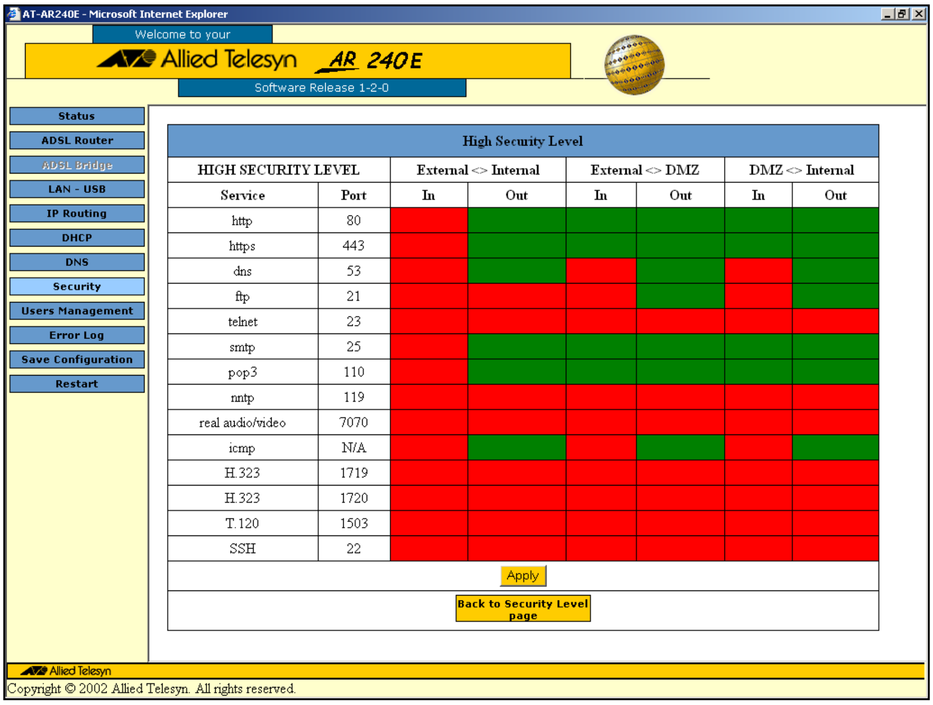
Figure 30. Low Security level



Medium Security Level

MEDIUM SECURITY LEVEL		External <> Internal		External <> DMZ		DMZ <> Internal	
Service	Port	In	Out	In	Out	In	Out
http	80	🟥	🟩	🟩	🟩	🟩	🟩
https	443	🟥	🟩	🟩	🟩	🟩	🟩
dns	53	🟥	🟩	🟩	🟩	🟩	🟩
ftp	21	🟥	🟩	🟩	🟩	🟩	🟩
telnet	23	🟥	🟩	🟥	🟩	🟥	🟩
smtp	25	🟥	🟩	🟩	🟩	🟩	🟩
pop3	110	🟥	🟩	🟩	🟩	🟩	🟩
nntp	119	🟥	🟩	🟩	🟩	🟩	🟩
real audio/video	7070	🟩	🟩	🟩	🟩	🟩	🟩
icmp	N/A	🟥	🟩	🟥	🟩	🟥	🟩
H.323	1719	🟥	🟩	🟥	🟩	🟥	🟩
H.323	1720	🟥	🟩	🟥	🟩	🟥	🟩
T.120	1503	🟥	🟩	🟥	🟩	🟥	🟩
SSH	22	🟥	🟩	🟥	🟩	🟥	🟩

Figure 31. Medium Security level



High Security Level

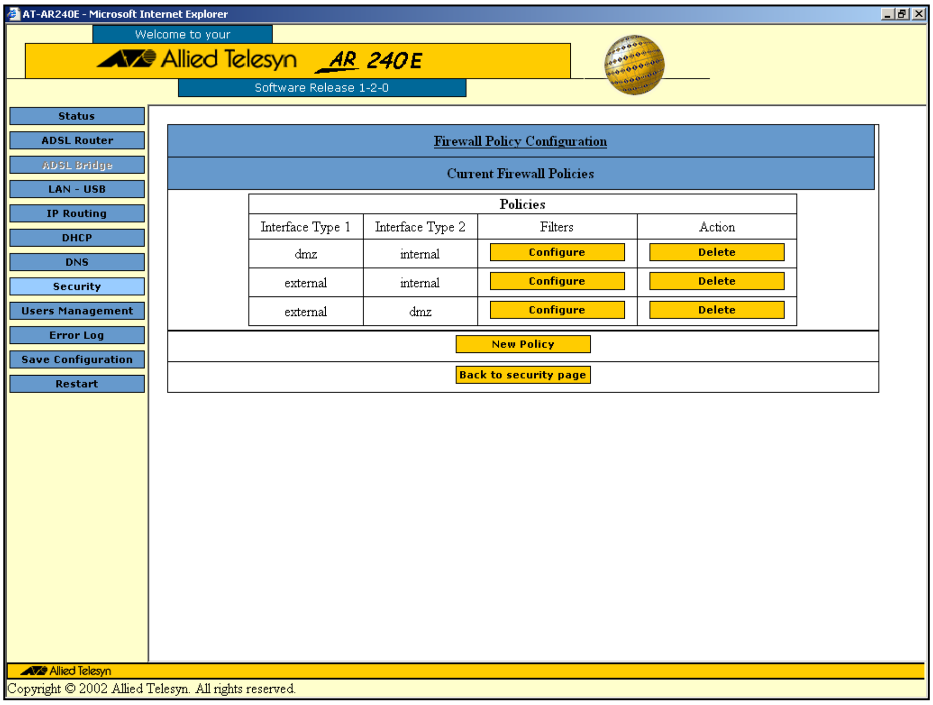
HIGH SECURITY LEVEL		External <> Internal		External <> DMZ		DMZ <> Internal	
Service	Port	In	Out	In	Out	In	Out
http	80	🟥	🟩	🟩	🟩	🟩	🟩
https	443	🟥	🟩	🟩	🟩	🟩	🟩
dns	53	🟥	🟩	🟥	🟩	🟥	🟩
ftp	21	🟥	🟥	🟥	🟩	🟥	🟩
telnet	23	🟥	🟥	🟥	🟥	🟥	🟥
smtp	25	🟥	🟩	🟩	🟩	🟩	🟩
pop3	110	🟥	🟩	🟩	🟩	🟩	🟩
nntp	119	🟥	🟥	🟥	🟥	🟥	🟥
real audio/video	7070	🟥	🟥	🟥	🟥	🟥	🟥
icmp	N/A	🟥	🟩	🟥	🟩	🟥	🟩
H.323	1719	🟥	🟥	🟥	🟥	🟥	🟥
H.323	1720	🟥	🟥	🟥	🟥	🟥	🟥
T.120	1503	🟥	🟥	🟥	🟥	🟥	🟥
SSH	22	🟥	🟥	🟥	🟥	🟥	🟥

Figure 32. High Security level

Otherwise it is possible to configure the firewall using a User Defined configuration. A User defined Configuration will consist of a number of Firewall policies.

To add a new policy:

1. click on `User Defined` button and a web page as in **Error! Reference source not found.** will appear
2. each policy has defined between a pair of interfaces
3. three policies have already defined. You can configure/delete one of this policy
4. clicking on `Configure policy` (e.g. between external and internal interfaces) a web page as in **Error! Reference source not found.** will appear
5. starting from here it is possible for example to ADD a TCP filter (*see Figure 35*).



Firewall Policy Configuration

Current Firewall Policies

Policies

Interface Type 1	Interface Type 2	Filters	Action
dmz	internal	Configure	Delete
external	internal	Configure	Delete
external	dmz	Configure	Delete

New Policy

Back to security page

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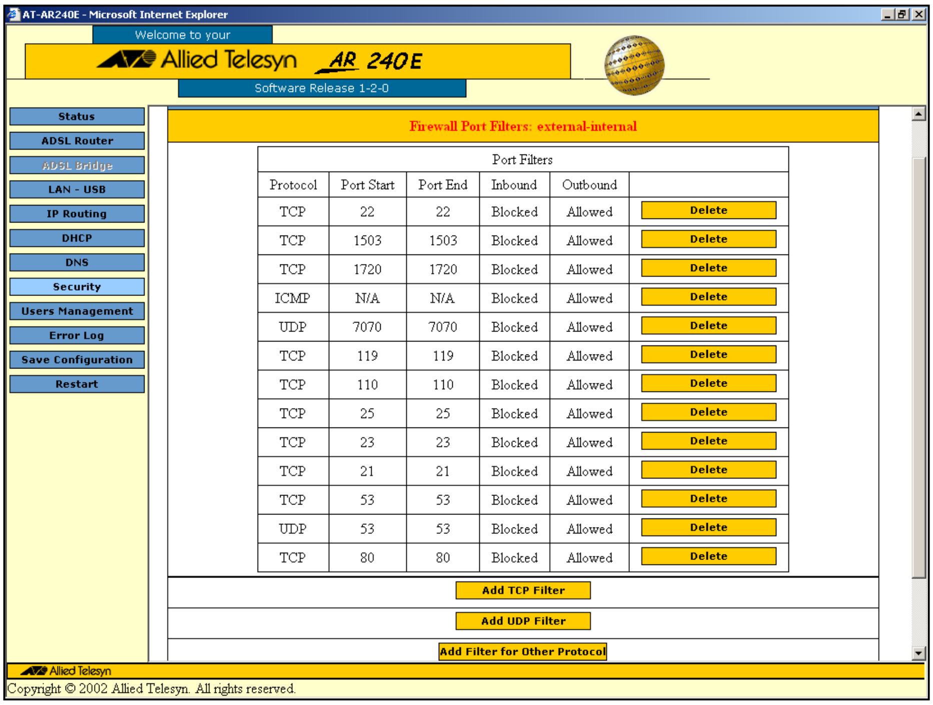
Figure 33. Current Firewall Policies



Firewall Port Filters: external-internal

Port Filters

Protocol	Port Start	Port End	Inbound	Outbound	
TCP	22	22	Blocked	Allowed	Delete
TCP	1503	1503	Blocked	Allowed	Delete
TCP	1720	1720	Blocked	Allowed	Delete
ICMP	N/A	N/A	Blocked	Allowed	Delete
UDP	7070	7070	Blocked	Allowed	Delete
TCP	119	119	Blocked	Allowed	Delete
TCP	110	110	Blocked	Allowed	Delete
TCP	25	25	Blocked	Allowed	Delete
TCP	23	23	Blocked	Allowed	Delete
TCP	21	21	Blocked	Allowed	Delete
TCP	53	53	Blocked	Allowed	Delete
UDP	53	53	Blocked	Allowed	Delete
TCP	80	80	Blocked	Allowed	Delete

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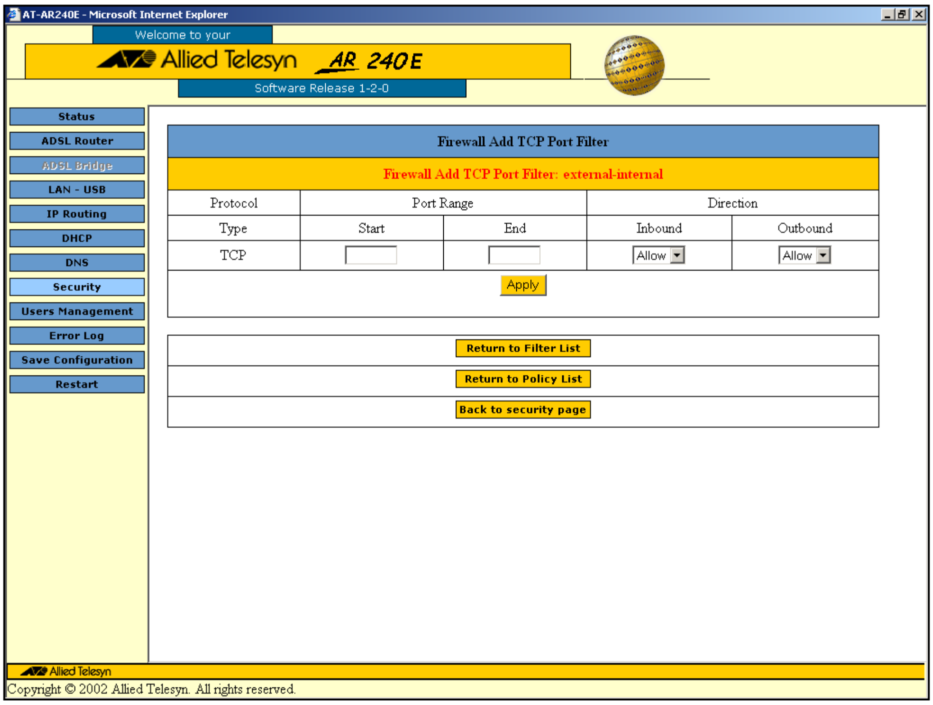
Figure 34. Firewall Port Filters



Firewall Add TCP Port Filter

Firewall Add TCP Port Filter: external-internal

Protocol	Port Range		Direction	
Type	Start	End	Inbound	Outbound
TCP			Allow	Allow

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Figure 35. Adding a new TCP filter

By default, no packets are allowed in through an external interface. All packets are allowed out through an internal interface.

So, typically, on a User-Defined firewall service, if we are changing default behaviour, we are allowing certain traffic types in through external and we are blocking certain traffic types from going out through internal interface

Precedence rule for overlapping filters

If multiple filters are configured on a policy, it is possible that they might overlap. For example, it is possible to configure:

- a filter to allow incoming TCP for ports 12 – 67
- a filter to block incoming TCP for ports 17-21

With a pair of filters like this, it is not immediately obvious what will happen to an incoming TCP packet to port 18 – will it be allowed or blocked?
To deal with situations like this, it is necessary to have a precedence rule for choosing between conflicting filters.
The rule is:

The packet will always be treated according to the most specific filter, regardless of the order in which the filters were added.

So, in the above case, an incoming TCP packet to port 18 will be blocked.

Configuration example 1 for Firewall

Suppose that we want to allow only Web sessions from remote hosts towards a local web server. Also, suppose that we do not allow access from local hosts on the LAN interface to remote hosts or remote servers.

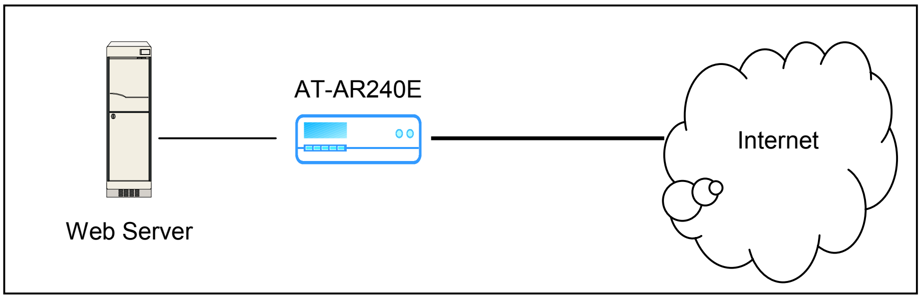


Figure 36. Firewall configuration example

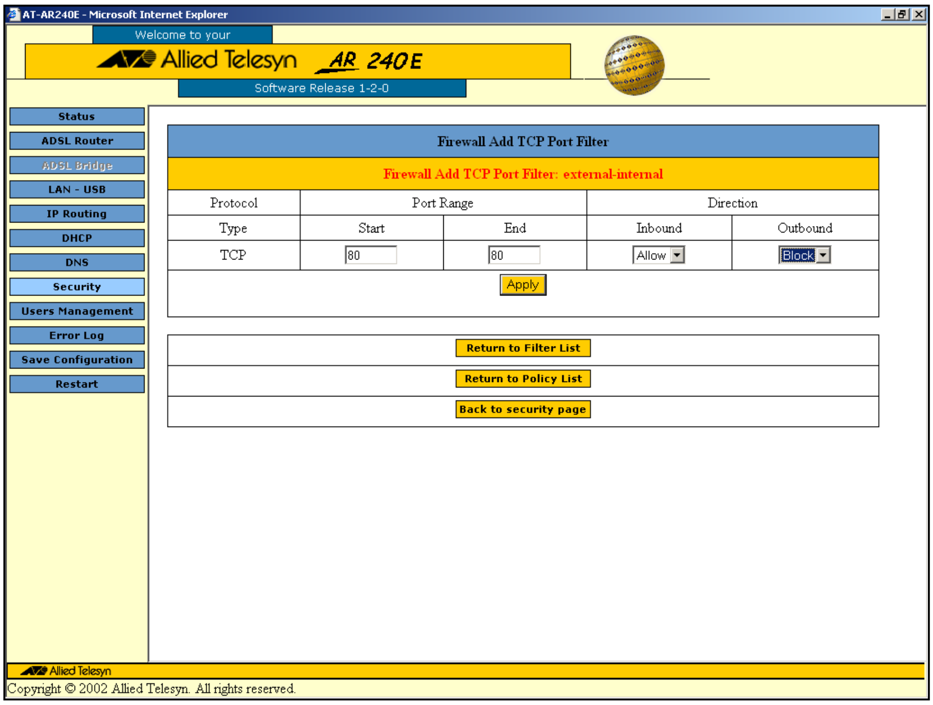
Using the Web interface this Firewall Service will be created as follows[1]:

[1] Note that we have already established an ADSL connection, we have defined external and internal interfaces and we have enabled NAT between the interfaces. Also, the Firewall has been enabled, and a user-defined policy created between Internal and External interfaces.

☞ *By default, no packets are allowed in through an external interface. Packets for most common applications are allowed out through an internal interface.*

1) The first step will be to delete the filter that allows outgoing TCP to port 80; after doing this we will have to replace it with a filter that blocks outgoing, and allows incoming, TCP for port 80
2) To perform this last step after clicking on the `Add TCP Filter` button, insert the following values and then click on "`APPLY`":

- `Port Range Start`: 80 (http session port)
- `Port Range End`: 80 (http session port)
- `Direction Inbound`: Allow (allow access to local web server from remote hosts)
- `Direction Outbound`: Block(block access to remote web servers from local hosts)



Firewall Add TCP Port Filter

Firewall Add TCP Port Filter: external-internal

Protocol	Port Range		Direction	
Type	Start	End	Inbound	Outbound
TCP	80	80	Allow	Block

Figure 37. Firewall Add TCP port filters

Dynamic Port Opening

To gain an understanding of the purpose of the Dynamic Port Opening feature, let us look at the operation of the FTP protocol

FTP PROTOCOL OPERATION

FTP is rather a difficult protocol for firewalls to deal with, for two reasons:

1) Whilst the management session of a FTP connection is an outgoing session to port 21, the data transfer session is an incoming session from port 20, so the firewall device has to handle incoming TCP sessions.
2) To add to the complexity, the TCP port to which the incoming connections will be made is not known in advance, but is communicated by the client to the server in a PORT command.

Here is a summary of the TCP packets exchanged in FTP :

- To FTP server's port 21 from a port > 1024 (Client initiates connection)
- From FTP server's port 21 to a port > 1024 (Server responds to client's control port)
- From FTP server's port 20 to a port > 1024 (Server initiates data connection to client's data port, which the client has specified to the server in a PORT command)
- To FTP server's port 20 from a port > 1024 (Client sends ACKs to server's data port)

When drawn out, the connection appears as follows:

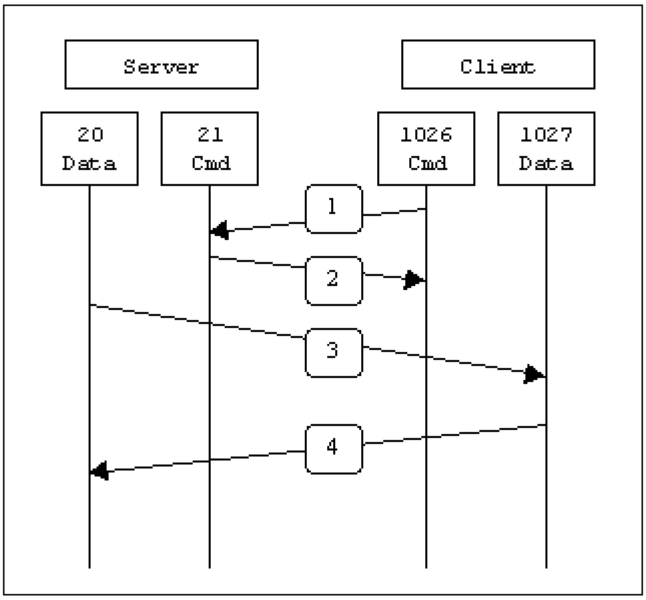


Figure 38. TCP flows in FTP

So, to allow clients on the private LAN to successfully interact with external FTP servers, the firewall must implicitly allow incoming TCP sessions to all manner of port numbers.
To have these parts permnantly open on the firewall would be a significant security risk.

The standard approach to dealing with the problem of applications like FTP has been for the firewall to have special code that understands the format of FTP packets. This code would intercept FTP packets as they went past, and extract information about which ports would be requested to be opened.
However, the problem with this approach is that every time a new Internet Application is developed, there potentially has to be new code added to the firewall to handle the new application.
The Dynamic Port Opening method used on the AT-AR240E takes a quite different approach. It is able to handle these port-number embedding applications without having to know the details of the format of the packets used in the application. It achieves this in the following way:
The user configures the router with a list of primary port numbers for the applications that they want the router to handle. The 'primary port number' refers to the TCP/UDP port number to which the primary (starting) session of the application is established.
Every time the router detects that an outgoing session has been established to one of these primary port numbers, it creates an entry in a table of currently open primary sessions. The table entry contains the IP addresses of the devices at each end of the session.
Subsequently, if an incoming session-establishment packet arrives at the router, the source and destination addresses of the packet are compared against the entries in the table of currently open primary sessions.
If there are no matches, the packet is discarded. If there are one or more matches, then the router carries out a port-probing process.
In the port-probing process, the router runs through the list of matching sessions. For each session, it sends a packet to private IP address in the table entry. The destination port number in this packet is the destination port number in the incoming packet.

For the case of TCP, the packet is a TCP SYN packet. For the case of UDP, the packet is just a small UDP packet.
Depending on the response that the router gets back from the probe packet, it can work out whether the local host was expecting to receiving an incoming session to that port number.
If the port probing process does find a local host that was expecting the incoming session, then the session is established. If a local host is not found, then the packet is discarded.

This mechanism enables the router to allow in only those incoming secondary sessions that should be allowed in, and can reject malicious attempts to establish incoming sessions.

☞ *Although FTP is given as an example of a protocol that requires dynamic port opening, because FTP is such a very common application, the dynamic port opening for FTP is enabled in the software by default, and does not have to be configured by the user.*

SPECIFIC FEATURES.

Non-Activity Timeout

The dynamic port opening process opens secondary ports, as described above. Typically, it will detect when a session using a secondary ports is being closed (ie and exchange of FIN, FIN/ACK packets) and stop passing packets for that session.

However, UDP sessions do not have a specific close-down process. Also, TCP sessions might be terminated without a proper close-down (for example, the host at one end of the session might be simply turned off). So, there needs to be a criterion for deciding when to remove a session in these cases. The method that the router uses is for the user to configure an inactivity time. If there has been no activity (no exchange of packets) on the secondary session for the specified period of time, the session is closed (ie the router will no longer forward any packets for that session).

Session Chaining

There are some applications (Netmeeting is the most well-known of these) in which the secondary sessions may, themselves, spawn their own secondary sessions. This process is known as session chaining. If a dynamic port opening definition is being configured for such an application, then the user needs to configure this definition to have session chaining on.

In this case, when secondary sessions are successfully established, the source/destination addresses of the session will also be added to the table of currently open primary sessions.

Binary address replacement

Some of the port-number embedding applications also embed IP addresses in packets. When NAT has been enabled, these embedded IP address will typically require translation (between Global IP address and appropriate local IP address). So, for these applications, the dynamic port opening definition needs to be configured with Binary address replacement on.

The binary address replacement process operates by searching right through each packet in the session for the address that is to be replaced. This will either be the global address or the local address, depending on which direction the packet is going. Every time the address is found, it is replaced with the corresponding address. So, this process does not require code that specifically understands the format of the packets. It simply searches for any occurence of the address it is interested in.

The parameters that can be set when configuring a dynamic port opening entry on the AR240E are:

- `Protocol`: TCP or UDP
- `Port range`: this defines a range of UDP or TCP destination port numbers. Sessions to these port numbers will be treated as primary sessions – ie sessions that will be put into the table that is examined when deciding whether to allow in a new session.
- `Allow multiple hosts`: this parameter sets if a secondary session (data session) with dynamic port opening can be started from different remote hosts.
- `Max activity interval`: this parameter specifies the time range during which the secondary port (data port) can be inactive before it is closed. Time is shown in milliseconds. Max value is 4*10e9
- `Enable session chaining`: this parameter enables TCP session chaining using a dynamic port opening for data sessions. Ie secondary sessions opened by the dynamic port opening process are, in turn, treated as primary sessions.
- `Enable UDP session chaining`: this parameter enables UDP session chaining using a dynamic port opening for data sessions. You must set Enable session chaining before setting this parameter.
- `Binary address replacement`: this parameter enables the address replacement for the incoming packets. This process is only operational if NAT is enabled. The purpose is to translate addresses that have been embedded in the payload of packets.
- `Address translation type`: this parameter specifies for what type of packets (TCP packets, UDP packets or both) there will be the address replacement. You must enable Binary address replacement before setting this parameter.

Configuration example 1 for Dynamic Port Opening

Suppose that a user connected to the LAN interface of the AT-AR240E wants to receive audio or video via RealPlayer from a remote RealServer (*see Figure 39*).

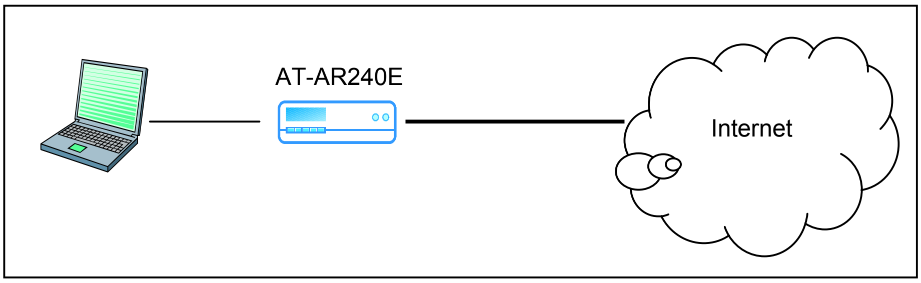
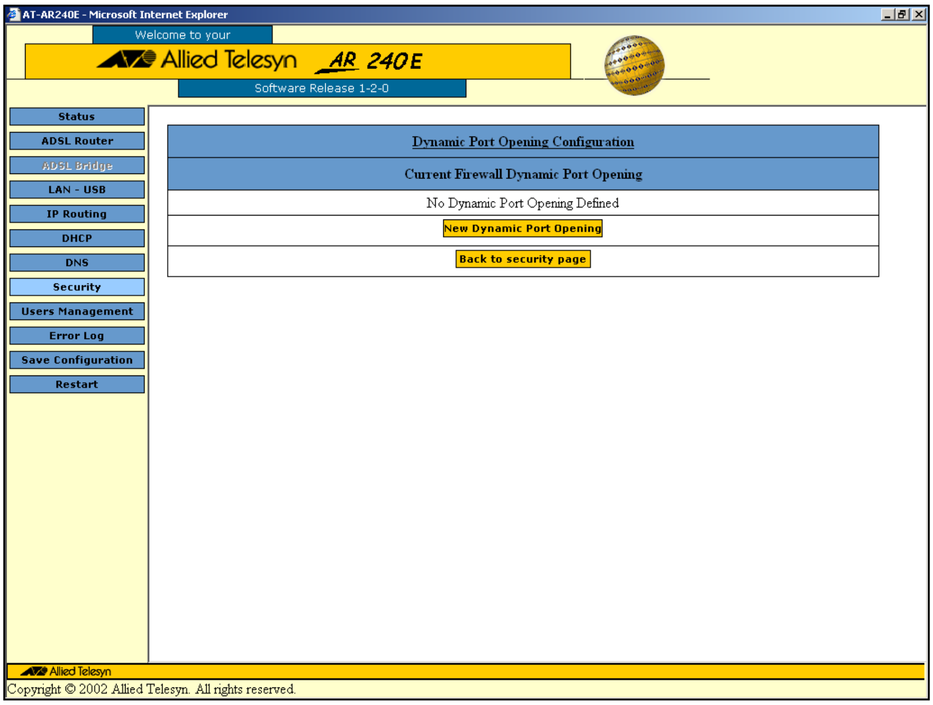


Figure 39. Dynamic port opening: connecting to an external RealServer

Using the Web interface this Dynamic Port Opening Service will be created as follows[2]:

1) Clicking on the Dynamic Port Opening Configure button a web page as in Figure 40 will appear



Dynamic Port Opening Configuration

Current Firewall Dynamic Port Opening

No Dynamic Port Opening Defined

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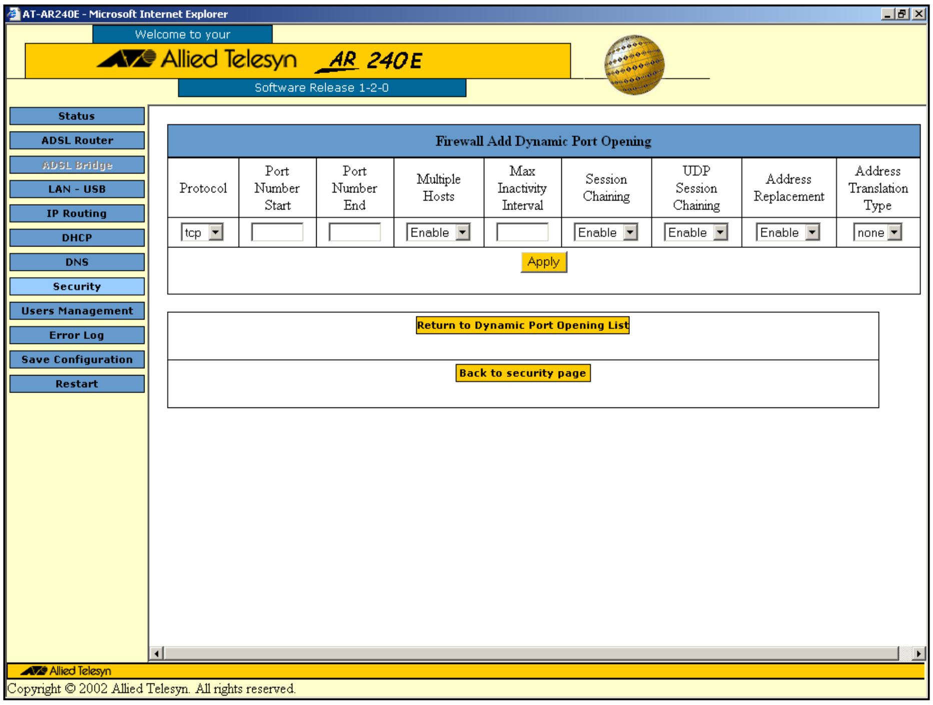
Figure 40. New Dynamic port opening

[2] Note that we have already established an ADSL connection, we have defined external and internal interfaces and we have enabled NAT between the interfaces.

2) After clicking on New Dynamic Port Opening a web page as in Figure 41 will appear:



Firewall Add Dynamic Port Opening

Protocol	Port Number Start	Port Number End	Multiple Hosts	Max Inactivity Interval	Session Chaining	UDP Session Chaining	Address Replacement	Address Translation Type
tcp			Enable		Enable	Enable	Enable	none

Apply

Return to Dynamic Port Opening List

Back to security page

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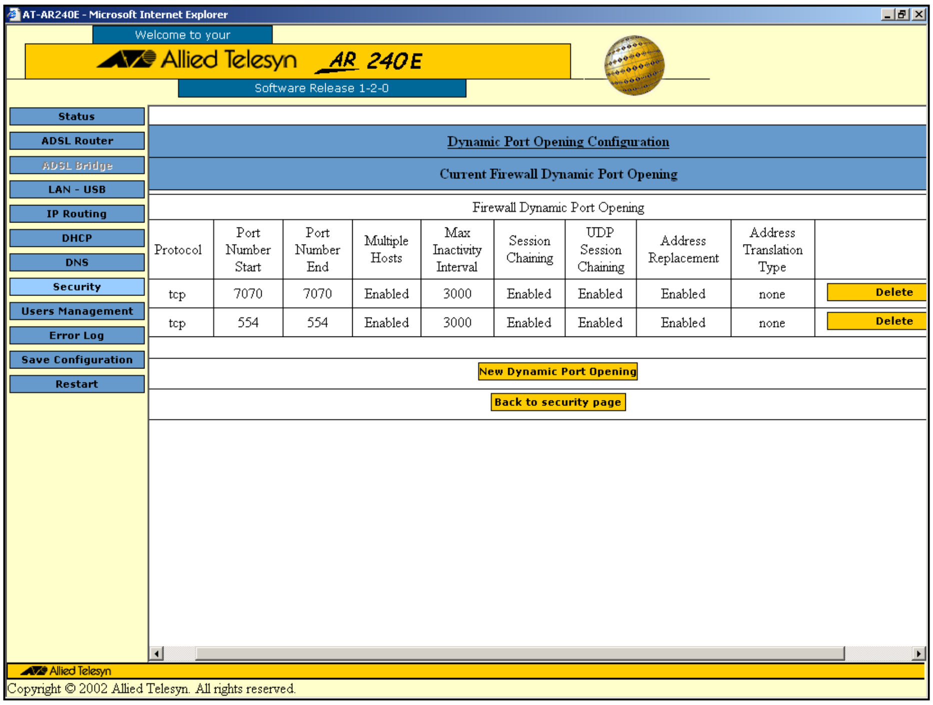
Figure 41. Dynamic port opening configuration

3) Insert the following values related to TCP port 554 and click on "APPLY":

- Protocol: TCP
- Port Number Start: 554 (RealPlayer control session port)
- Port Number End: 554 (RealPlayer control session port)
- Multiple hosts: Enable
- Max Activity Interval: 3000 (seconds)
- Session Chaining: Enable
- UDP Session Chaining: Enable
- Address Replacement: Enable
- Address Translation Type: none

4) Insert the following values related to TCP port 7070 and click on "APPLY":

- Protocol: TCP
- Port Number Start: 7070 (RealPlayer control session port)
- Port Number End: 7070 (RealPlayer control session port)
- Multiple hosts: Enable
- Max Activity Interval: 3000 (seconds)
- Session Chaining: Enable
- UDP Session Chaining: Enable
- Address Replacement: Enable
- Address Translation Type: none



Dynamic Port Opening Configuration

Current Firewall Dynamic Port Opening

Firewall Dynamic Port Opening

Protocol	Port Number Start	Port Number End	Multiple Hosts	Max Inactivity Interval	Session Chaining	UDP Session Chaining	Address Replacement	Address Translation Type	
tcp	7070	7070	Enabled	3000	Enabled	Enabled	Enabled	none	Delete
tcp	554	554	Enabled	3000	Enabled	Enabled	Enabled	none	Delete

Figure 42. Dynamic Port Opening settings for Real Player Applications

Configuration example 2 for Dynamic Port Opening

Suppose that a user connected to the LAN interface of the AT-AR240E wants to establish a Netmeeting session with a remote host (see *Figure 43*)

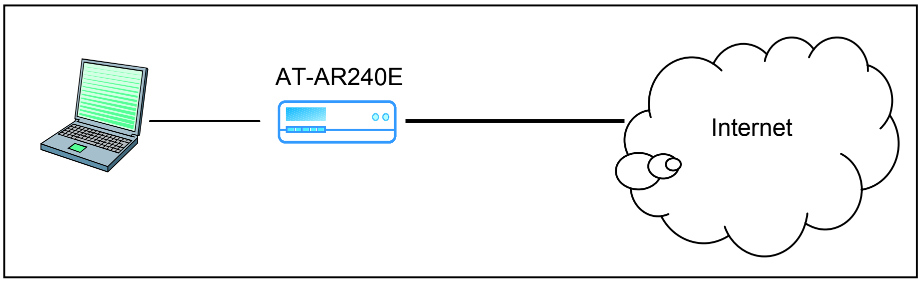


Figure 43. Dynamic port opening: establishing a Netmeeting session

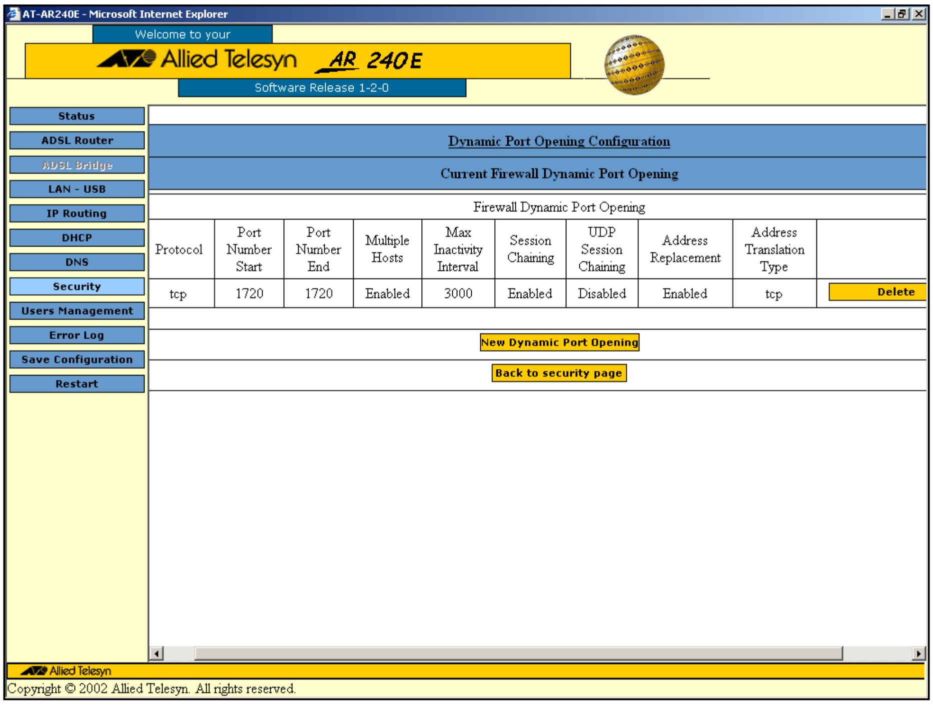
Using the Web interface this Dynamic Port Opening Service will be created as follows[3]:

The first two steps are the same of the previous configuration example.

1) To define the Dynamic Port Opening insert the following values and click on `"APPLY"` (*see Figure 44*):

- Protocol: TCP
- Port Number Start: 1720 (H.323 control session port)
- Port Number End: 1720 (H.323 control session port)
- Multiple hosts: Enable
- Max Activity Interval: 3000 (seconds)
- Session Chaining: Enable
- UDP Session Chaining: Disable
- Address Replacement: Enable
- Address Translation Type: TCP

[3] Note that we have already established an ADSL connection, we have defined external and internal interfaces and we have enabled NAT between the interfaces.



Dynamic Port Opening Configuration

Current Firewall Dynamic Port Opening

Firewall Dynamic Port Opening

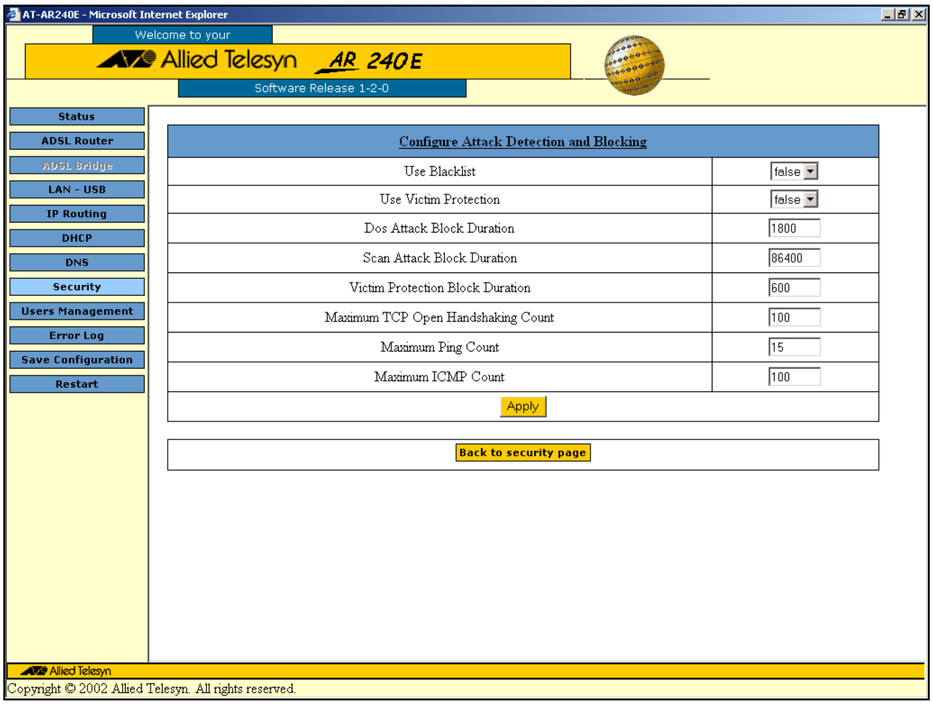
Protocol	Port Number Start	Port Number End	Multiple Hosts	Max Inactivity Interval	Session Chaining	UDP Session Chaining	Address Replacement	Address Translation Type	
tcp	1720	1720	Enabled	3000	Enabled	Disabled	Enabled	tcp	Delete

Figure 44. Dynamic port opening settings for Netmeeting applications

Attack Detection and Blocking

Clicking on the 'Attack Detection and Blocking' Configure button, a web page as in Figure 45 will appear.
The following parameters can be set:

- Use blacklist: this parameter enables the use of a blacklist where the router blocks a host IP address if it detects an intrusion from that host. All packets from the host are dropped for ten minutes.
- Use victim protection: this parameter enables the protection from spoofing attacks. When a spoofing attack towards an internal host is detected, the router discards the packets arriving from the attacking host.
- Dos attack block duration: this parameter sets the block duration (in seconds) for access to router from an attacking host that has performed a DOS attack. Max value is 4*10e9
- Scan attack block duration: this parameter sets the block duration (in seconds) for access to router from an attacking host that has performed a Scan attack. Max value is 4*10e9
- Victim protection block duration: this parameter sets the block duration (in seconds) for access to router from an attacking host that has performed a spoofing attack. Max value is 4*10e9
- Maximum TCP open handshaking count: this parameter sets the maximum number of unfinished TCP handshaking sessions per second allowed before a SYN flood (Dos attack) is detected. Max value is 4*10e9
- Maximum ping count: this parameter sets the maximum number of Pings per second allowed before an Echo storm (Dos attack) is detected. Max value is 4*10e9
- Maximum ICMP count: this parameter sets the maximum number of ICMP packets per second allowed before an ICMP flood (Dos attack) is detected. Max value is 4*10e9



Configure Attack Detection and Blocking

Use Blacklist	false
Use Victim Protection	false
Dos Attack Block Duration	1800
Scan Attack Block Duration	86400
Victim Protection Block Duration	600
Maximum TCP Open Handshaking Count	100
Maximum Ping Count	15
Maximum ICMP Count	100

Apply

Back to security page

Figure 45. Attack Detection and Blocking web page

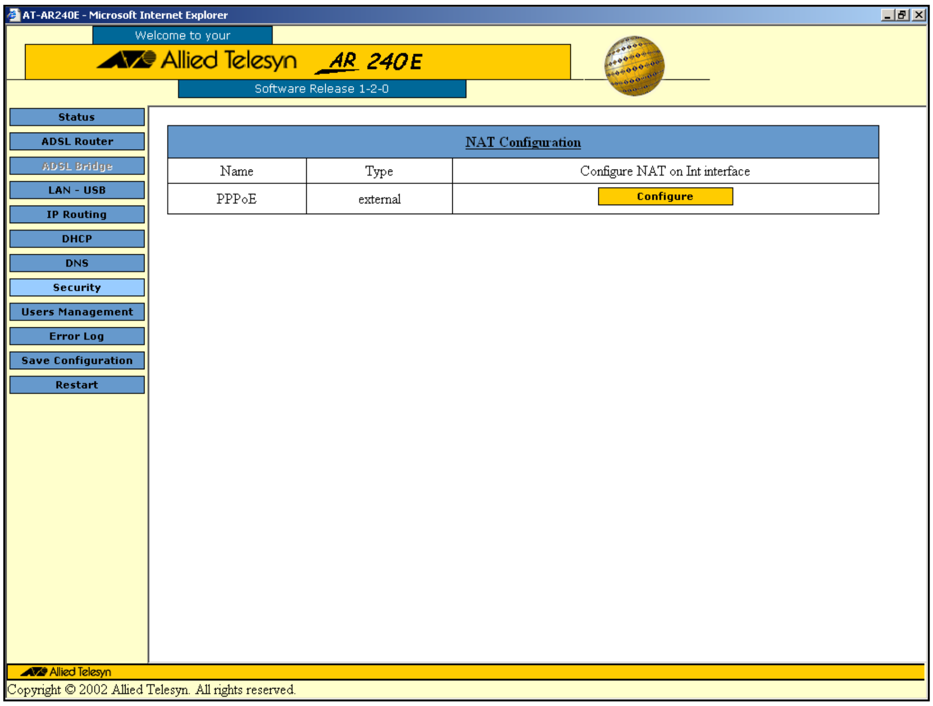
NAT

An introduction to NAT can be found in Appendix E.
On the AT-AR240E, NAT policies are created between pairs of interfaces. One of the interface in any GIVEN policy pair must be an external interface.

No NAT services are available between the following pairs of interfaces:

External/DMZ
Internal/DMZ

So, let us look at configuring NAT in a case where one external and one internal interface have been associated to the Security module.
Clicking on the Configure NAT button a web page as in Figure 46 will appear.

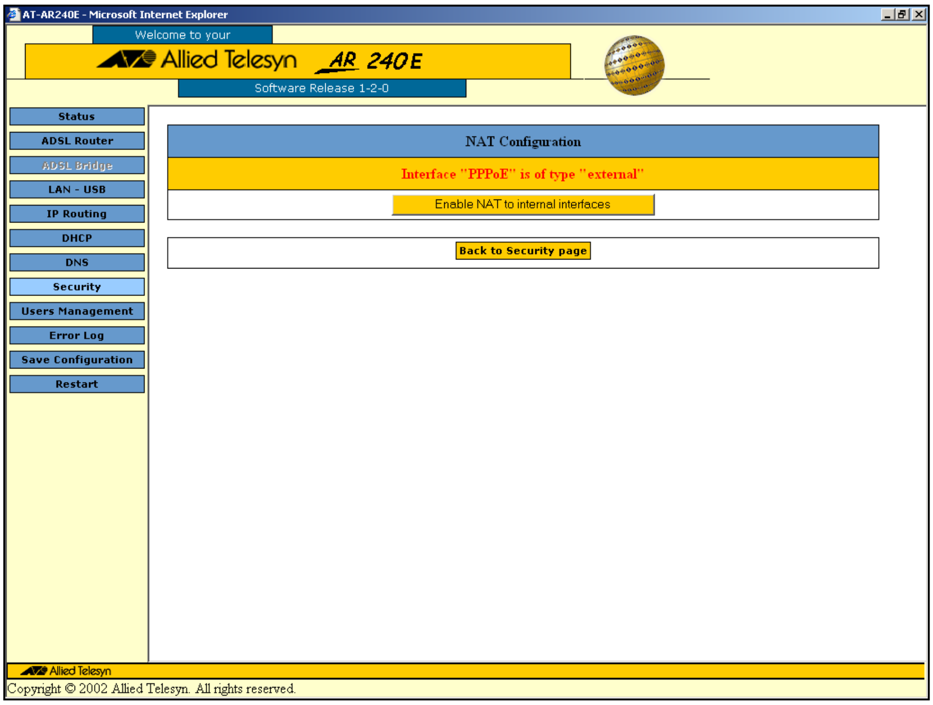


NAT Configuration

Name	Type	Configure NAT on Int interface
PPPoE	external	Configure

Figure 46. NAT configuration Web Page

Suppose that we want to enable the NAT between the PPP over Ethernet (external) and LAN (internal) interface. Clicking on the corresponding `Configure` button, the following web page will appear.



NAT Configuration

Interface "PPPoE" is of type "external"

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Figure 47. NAT enabling Web Page

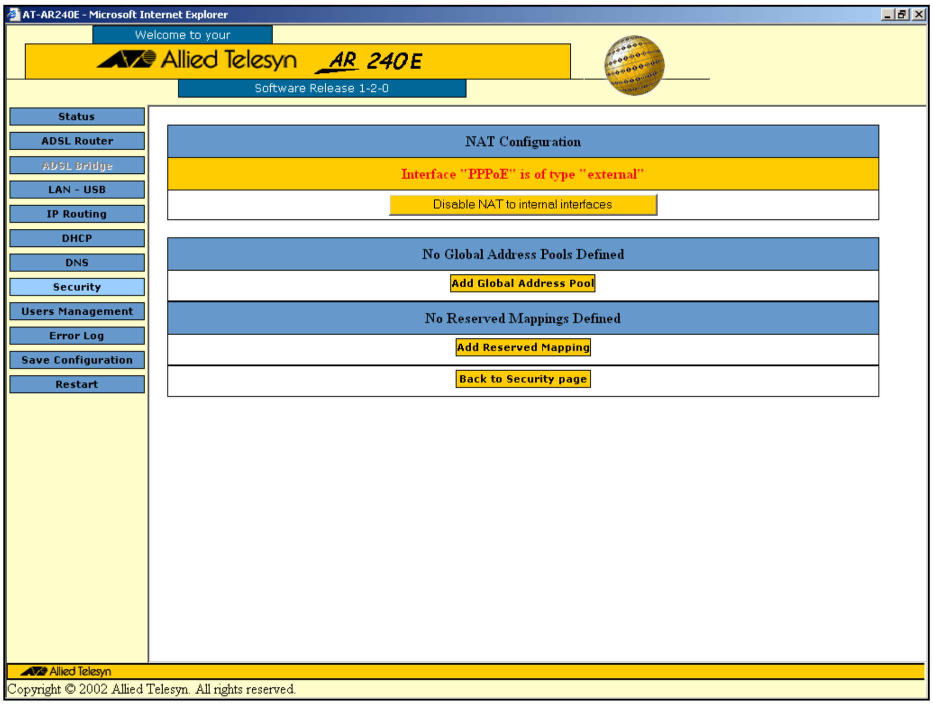
After clicking on “Enable NAT to Internal Interface” a NAT policy between these two interfaces is created. So now:

- all sessions originating from hosts on the internal LAN destined for the external interface will have their source address replaced by the IP address on the external interface.
- It will not be possible to initiate incoming sessions from beyond the external interface to hosts on the LAN.

This is the default behaviour for a NAT policy between an internal and an external interface. But you may wish to add non-default facilities to this policy.

The NAT configuration page (*see Figure 48*) enables you to do so. The items that this page enables you to configure are:

- a `Global Address Pool`: this is a pool of addresses that are associated with the external interfaces. The addresses can be used as source address for outgoing sessions and with the right Reserved Mappings, destination addresses for incoming sessions.
  NOTE: you need to make special arrangements with your service provider in order to obtain the addresses to be used in a global address pool
- `Reserved mapping`: this is a mapping to enable incoming sessions to access hosts on the internal LAN. The mapping configures the router so that packets arriving from outside to a particular global address will be forwarded to a particular internal host.



NAT Configuration

Interface "PPPoE" is of type "external"

No Global Address Pools Defined

No Reserved Mappings Defined

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Figure 48. NAT related setting

The best way to illustrate the use of Global address pools and Reserved Mapping is to look at some configuration examples.

Configuration example 1 for NAT

Suppose that an FTP server is running on a host on the internal side of the AT-AR240E and you want to permit the access to this server from remote hosts (*see Figure 49*).

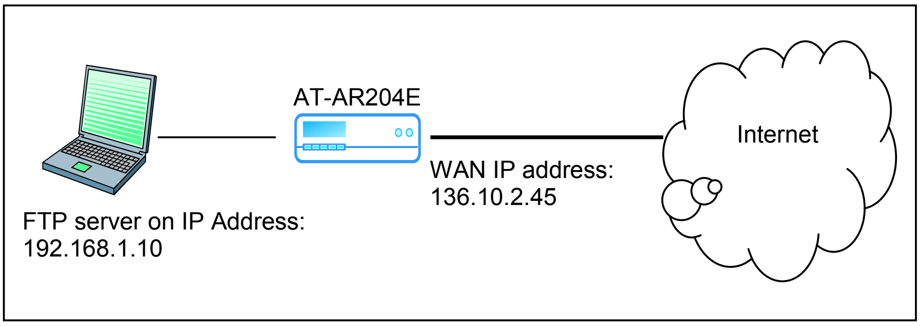
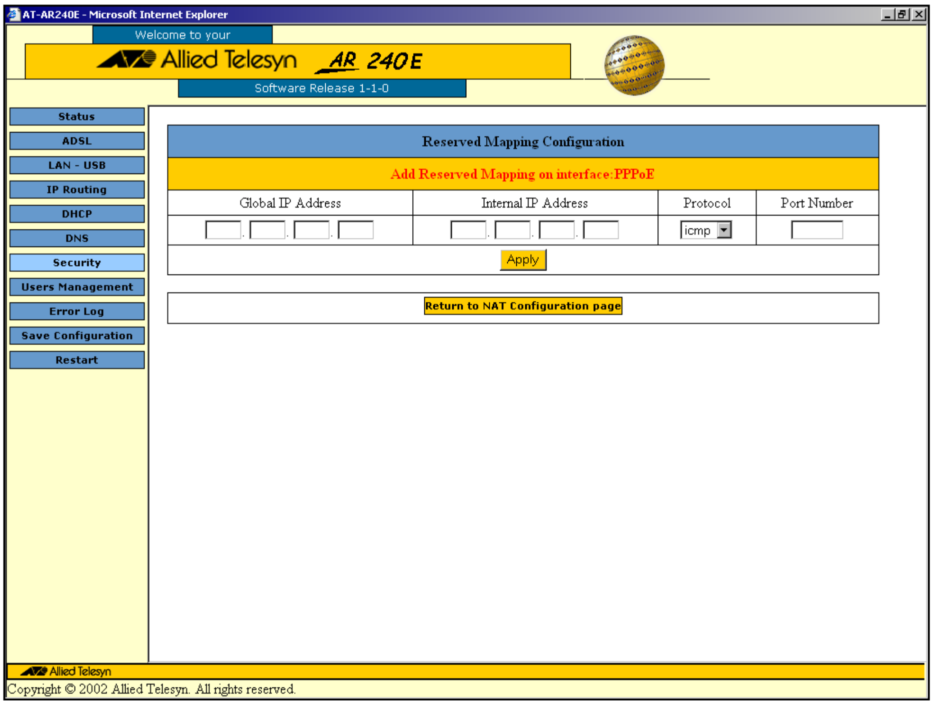


Figure 49. NAT services: ftp access from external

Using the Web interface this Reserved Mapping Service will be created as follows[4]:

1) Clicking on the `Add Reserved Mapping` button a web page as in Figure 50 will appear



Reserved Mapping Configuration

Add Reserved Mapping on interface:PPPoE

Global IP Address	Internal IP Address	Protocol	Port Number
. . .	. . .	icmp	

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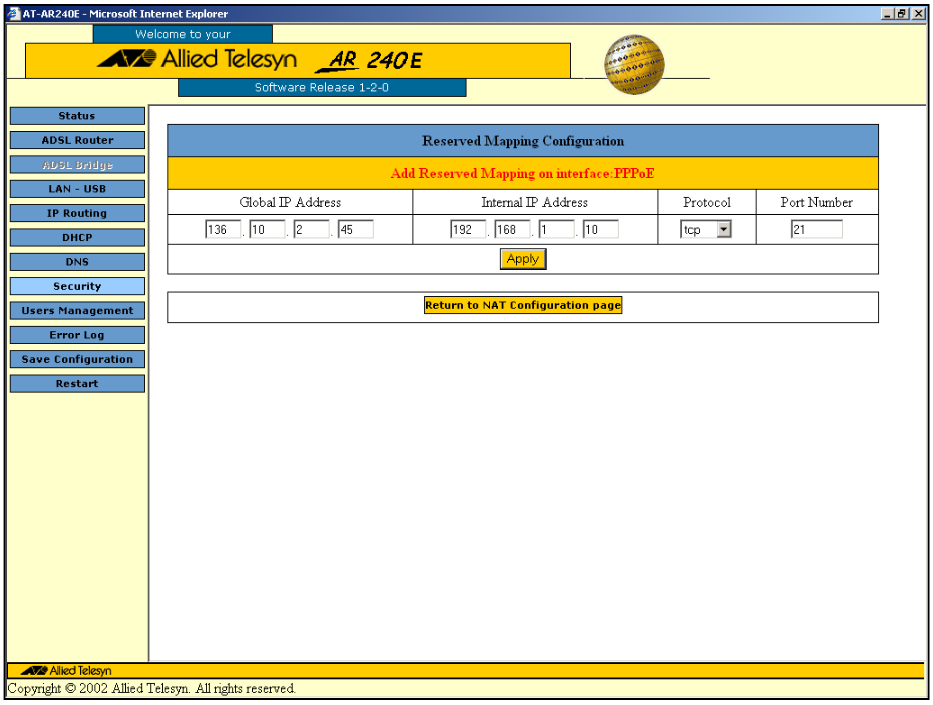
Figure 50. Reserved Mapping Configuration

[4] Note that we have already established an ADSL connection, we have defined external and internal interfaces and we have enabled NAT between the interfaces.

2) Insert the following values:

- `Global IP Address`: 136.10.2.45 (ADSL interface IP address)
- `Internal IP Address`: 192.168.1.10 (FTP server IP address)
- `Protocol`: TCP
- `Port Number`: 21 (ftp control session port)



Reserved Mapping Configuration

Add Reserved Mapping on interface:PPPoE

Global IP Address	Internal IP Address	Protocol	Port Number
136 . 10 . 2 . 45	192 . 168 . 1 . 10	tcp	21

Figure 51. Reserved Mapping settings

Clicking on APPLY, the Reserved Mapping will be created.

Now, any TCP packets arriving at the external port with destination IP address 136.10.2.45 and destination port 21 will be forwarded to the local host 192.168.1.10.

Configuration example 2 for NAT

Suppose that a user connected to the LAN interface of the AT-AR240E has an FTP server on a local host and a Web server on another local host and he wants to permit the access from remote hosts (*see Figure 52*)

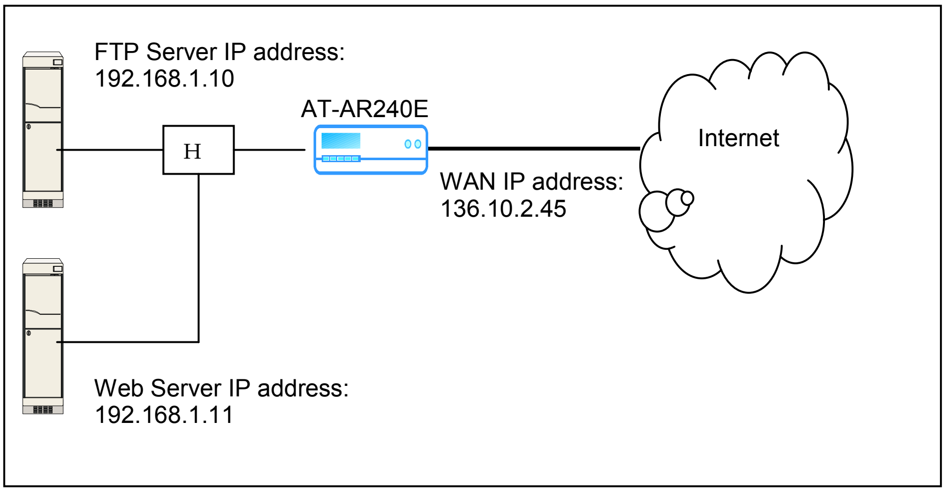


Figure 52. NAT services: ftp and http access from external

Using the Web interface this Reserved Mapping Service will be created as follows[5]:
The same steps as in the previous configuration example should be followed using these values:

- `Global IP Address`: 136.10.2.45 (ADSL interface IP address)
- `Internal IP Address`: 192.168.1.10 (FTP server IP address)
- `Protocol`: TCP
- `Port Number`: 21 (ftp control session port)

The FTP server reserved mapping configuration, and

- `Global IP Address`: 136.10.2.45 (ADSL interface IP address)
- `Internal IP Address`: 192.168.1.11 (Web server IP address)
- `Protocol`: TCP
- `Port Number`: 80 (Http session port)

The WEB Server reserver mapping configuration.

[5] Note that we have already established an ADSL connection, we have defined external and internal interfaces and we have enabled NAT between the interfaces.

Configuration example 3 for NAT

Suppose that a user connected to the LAN interface of the AT-AR240E wants to connect to a remote Private LAN (i.e Company Intranet) using an IPSEC tunnel.

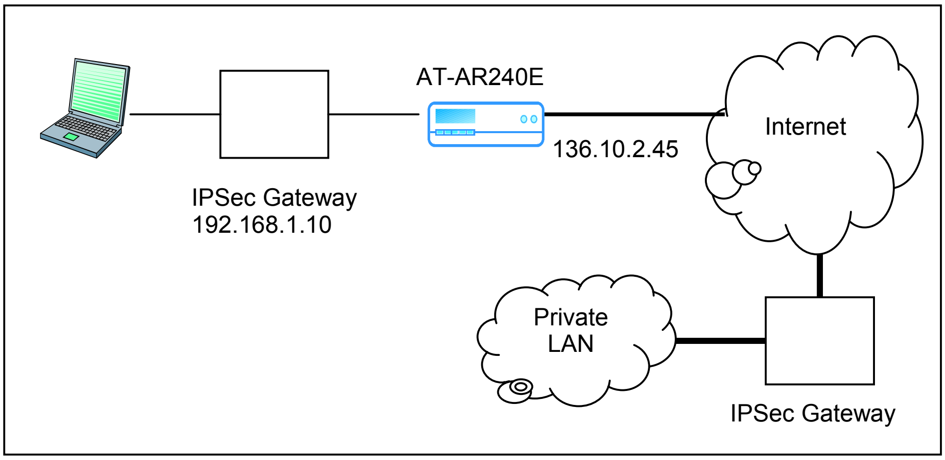


Figure 53. NAT services: IPSec connection

To enable the tunnel to operate, IPSEC packets must to able to reach the IPSEC gateway device, so a reserved mapping for incoming IPSEC packets must be defined.

Using the Web interface this Reserved Mapping Service will be created as follows[6]:

The same steps as in the previous configuration example should be followed using these values:

- `Global IP Address`: 136.10.2.45 (ADSL interface IP address)
- `Internal IP Address`: 192.168.1.10 (PC host IP address)
- `Protocol`: IPSEC
- `Port Number`: 0 (i.e. a null port number as the protocol is not TCP or UDP)

[6] Note that we have already established an ADSL connection, we have defined external and internal interfaces and we have enabled NAT between the interfaces.

Configuration example 4 for NAT

Suppose that a user connected to the LAN interface of the AT-AR240E has two FTP servers on two different local hosts and two public IP addresses (provided by its ADSL service provider).

Suppose that he wants to permit the access to both the FTP servers from remote hosts using both public addresses (*see Figure 54*)

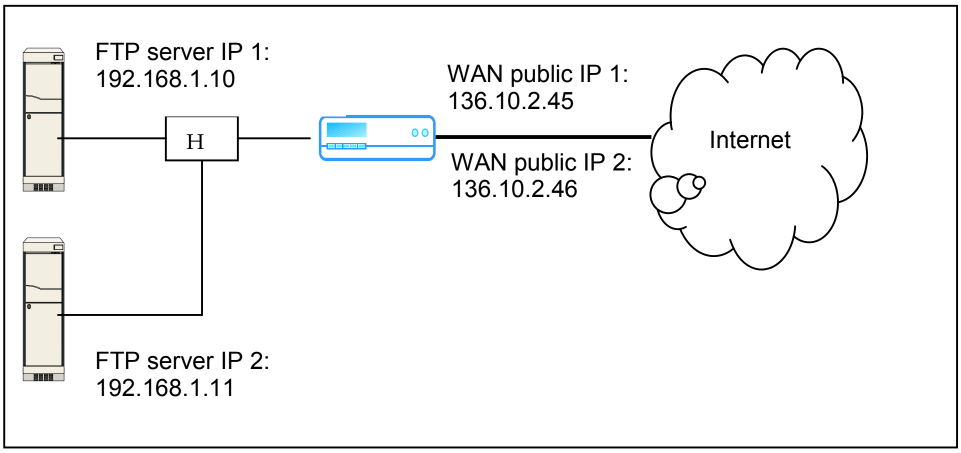
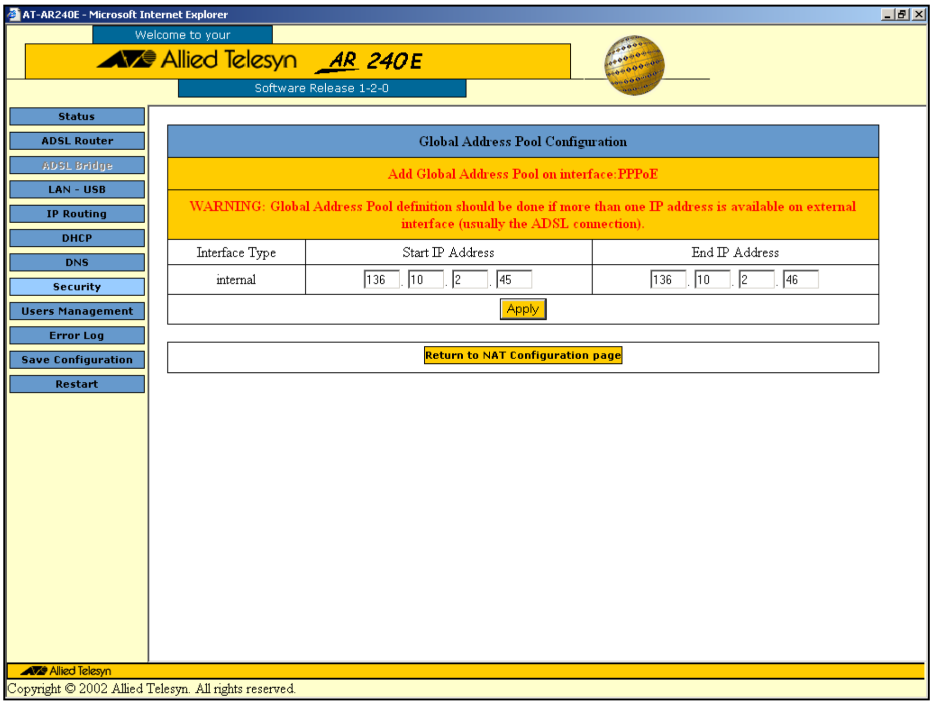


Figure 54. NAT services: using two public IP adresses

First a Global address pool will need to be created, containing the address 136.10.2.45 – 136.10.2.46:

1) Click on Add Global Address Pool, insert the following values and click on APPLY (*see Figure 55*):

- Start IP Address: 136.10.2.45 (first public IP address)
- End IP Address: 136.10.2.46 (second public IP address)
- Interface Type: internal



Global Address Pool Configuration

Add Global Address Pool on interface:PPPoE

WARNING: Global Address Pool definition should be done if more than one IP address is available on external interface (usually the ADSL connection).

Interface Type	Start IP Address	End IP Address
internal	136 . 10 . 2 . 45	136 . 10 . 2 . 46

Apply

Return to NAT Configuration page

Figure 55. Global Address Pool settings

Add a reserved mapping following the steps described in the Configuration example 3 using the following values:

- Global IP Address: 136.10.2.45 (ADSL interface IP address)
- Internal IP Address: 192.168.1.10 (FTP server IP address)
- Protocol: TCP
- Port Number: 21 (ftp control session port)

The same steps have to be followed for configuring the second FTP server using the following values:

- Global IP Address: 136.10.2.46 (ADSL interface IP address)
- Internal IP Address: 192.168.1.11 (FTP server IP address)
- Protocol: TCP
- Port Number: 21 (ftp control session port)

Interactions of NAT and other security features.

Firewall filters and reserved mappings.

So far, the NAT reserved mappings have been considered independently of the firewall. If the firewall is not enabled, then all that is required to enable NAT to allow in TCP sessions to a certain port number is to create a reserved mapping for that particular TCP port number.

However, if the firewall is enabled, we have a matter of precedence to consider. If:

- *a reserved mapping has been created for a particular TCP port*
- *the firewall is not configured to allow in TCP data for that port*

then which will take precedence? Will NAT's desire to allow the data in be overruled by the firewall's desire to keep it out?

The answer is that the blocking by the firewall will take precedence.

So, when the firewall has been enabled, then care must be taken to ensure that when NAT reserved mapping are created, the firewall is also configured to allow in the traffic for which the reserve mapping is defined.

NAT and Dynamic Port Opening

The description of Dynamic Port Opening discussed that feature in the context of the firewall – ie the Dynamic Port Opening feature was presented as being required to allow secondary sessions in through the firewall.
It should be noted that, by default, incoming sessions are not allowed through by NAT either. So, if NAT is enabled, even if the firewall is not enabled, then if you wish to be able to access services that involve incoming secondary sessions, then you will need to create Dynamic Port Opening definitions for those services.

So, for example, if you have NAT enabled on the router, and wish for users on the LAN to be able to successfully access external RealServers, it will be necessary to create a dynamic port opening definition as shown in Configuration Example 1 for Dynamic Port Opening.

Chapter 7

SNMP

Introduction

Simple Network Management Protocol (SNMP)

The AT-AR240E device can be monitored/configured using the SNMP protocol.

The Simple Network Management Protocol (SNMP) is the network management protocol of choice for the Internet and IP-based internetworks.

The SNMP protocol provides a mechanism for management entities, or stations, to extract information from the Management Information Base (MIB) of a managed device.

The standard way of accessing information contained in a MIB file is to use a Network Management Station (NMS), typically a PC or workstation, to send commands to the managed device using the SNMP protocol.

SNMP can use a number of different protocols as its underlying transport mechanism, but the most common transport protocol is UDP.

☞ *SNMP trap messages are sent to UDP port 162; all other SNMP messages are sent to UDP port 161.*

Communities and Views

A community is a relationship between an NMS and an agent. The community name is used like a password for a trivial authentication scheme.

An SNMP MIB view is an arbitrary subset of objects in the MIB. Objects in the view may be from any part of the object name space, and not necessarily the same sub-tree.

An SNMP community profile is the pairing of an SNMP access mode (read-only or read-write) with the access mode defined by the MIB for each object in the view. A pairing of an SNMP community and an SNMP community profile determines the level of access that the agent affords to an NMS that is a member of the specified community. When an agent receives an SNMP message it checks the community name encoded in the message. If the agent knows the community name, the message is deemed to be an authentic SNMP message and the sending SNMP entity is accepted as a member of the community.

The community profile associated with the community name then determines the sender's view of the MIB and the operations that can be performed on objects in the view.

AT-AR240E Console

The AT-AR240E console is used for configuring the snmp module.
A TELNET session has to be established to access the AT-AR240E console.
To start a TELNET session, do one of the following:

- *From your Windows PC open a DOS shell and type the following command:* `telnet x.y.z.u` *where* `x.y.z.u` *is the AT-AR240E LAN/USB/WAN IP address and press [Enter]; after a while the AT-AR240E login prompt appears.*
- *From your Linux PC open a BASH shell and type the following command: "*`telnet x.y.z.u`*" where "*`x.y.z.u`*" is the AT-AR240E LAN/USB/WAN IP address and press [Enter]; after a while the AT-AR240E login prompt appears.*

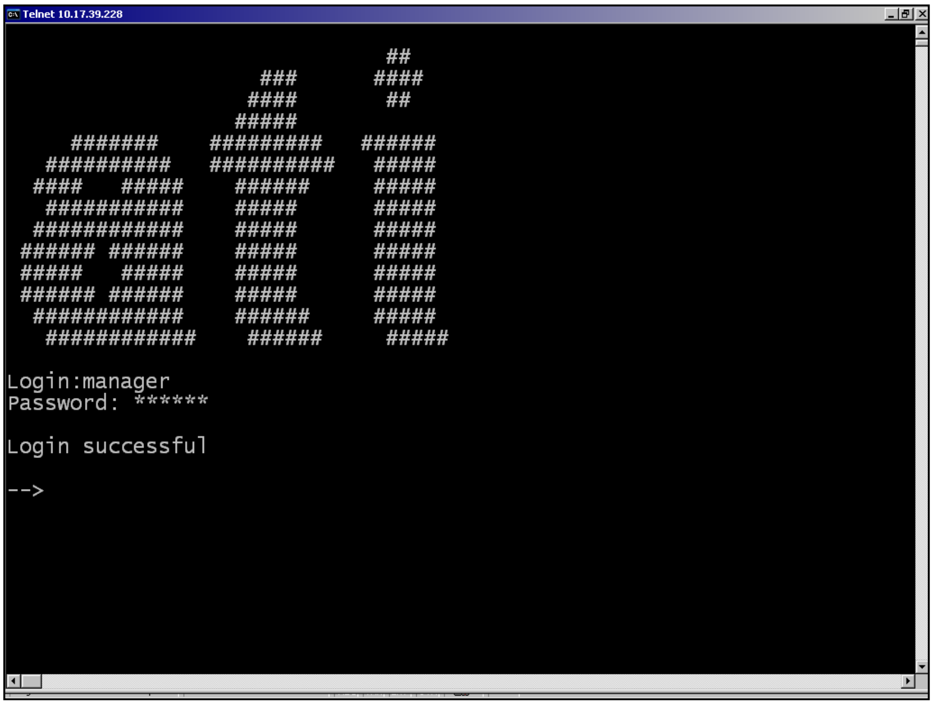
☞ *Login into the AT-AR240E using an Administrator account, for example the factory default has a* manager *account with an initial password* friend.

Enter your login name at the login prompt (*see 0*):

```
login: manager
```

Enter the password at the password prompt:

```
password: friend
```

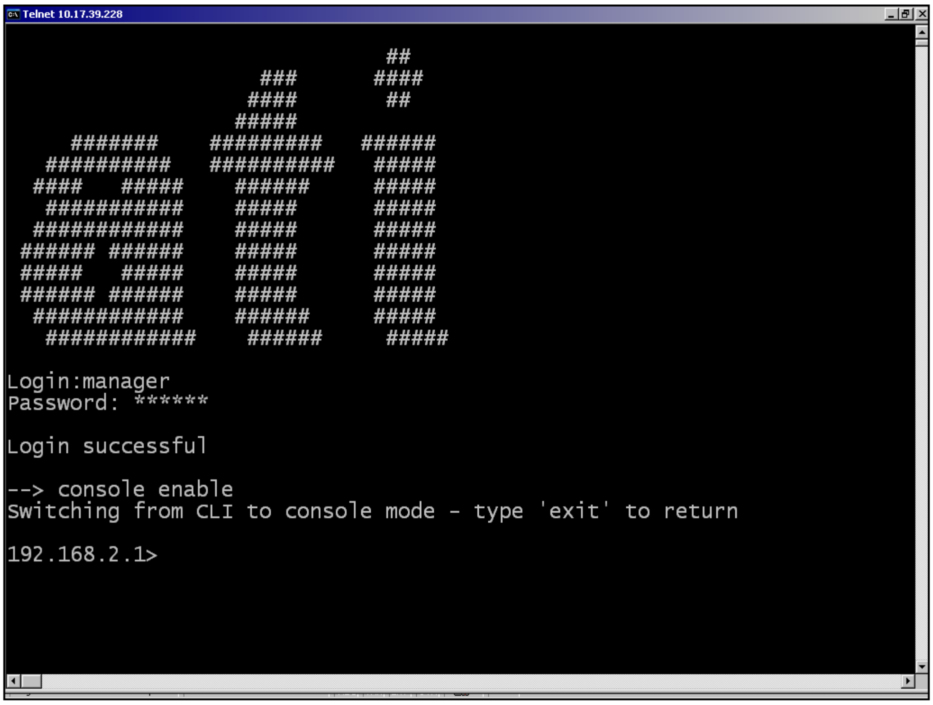


```
                              ##
                    ###      ####
                   ####       ##
                  #####
     #######    #########   ######
   ##########   ##########   #####
  ####   #####    ######     #####
   ###########    #####      #####
  ############    #####      #####
 ###### ######    #####      #####
 #####   #####    #####      #####
 ###### ######    #####      #####
  ############    ######     #####
   ############    ######     #####

Login:manager
Password: ******

Login successful

-->
```

AT-AR240E console login

The SNMP related commands are a subset of the AT-AR240E console; to have access to these settings first of all enter the following command and press [enter] twice (*see Figure 56*):

```
→ console enable
```

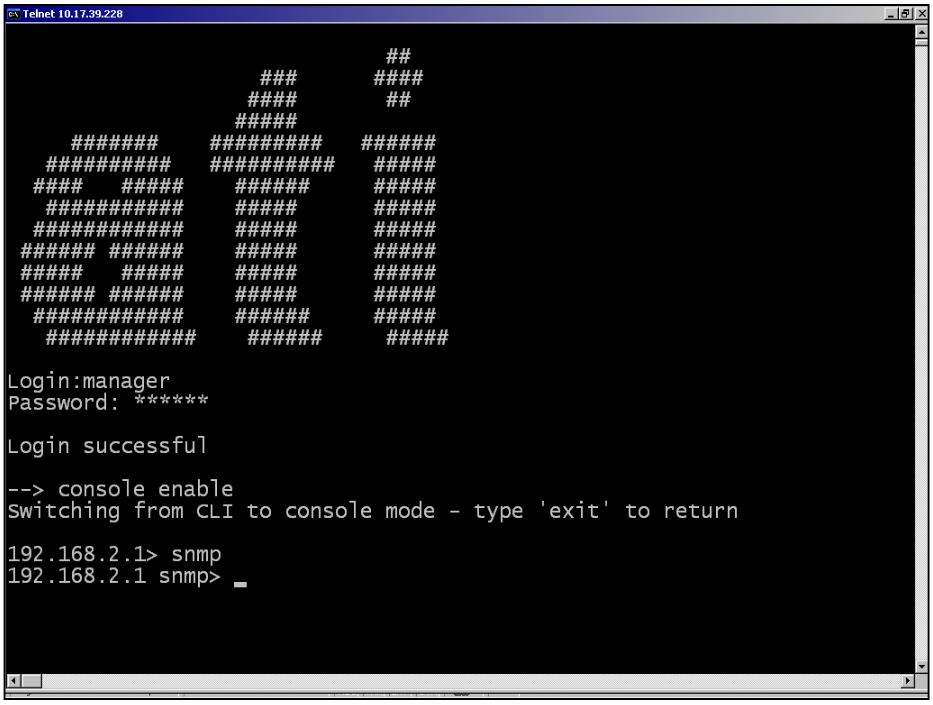


```
                              ##
                    ###      ####
                   ####       ##
                  #####
     #######    #########   ######
   ##########   ##########   #####
  ####   #####    ######     #####
   ###########    #####      #####
  ############    #####      #####
 ###### ######    #####      #####
 #####   #####    #####      #####
 ###### ######    #####      #####
  ############    ######     #####
   ############    ######     #####

Login:manager
Password: ******

Login successful

--> console enable
Switching from CLI to console mode - type 'exit' to return

192.168.2.1>
```

Figure 56. AT-AR240E console

The prompt will change indicating the LAN/USB interface IP address (e.g. 192.168.2.1); now enter the following command in order to access to the SNMP module and press [enter] (*see Figure 57*):

```
192.168.2.1> snmp
```



```
                              ##
                    ###      ####
                   ####       ##
                  #####
     #######    #########   ######
   ##########   ##########   #####
  ####   #####    ######     #####
   ###########    #####      #####
  ############    #####      #####
 ###### ######    #####      #####
 #####   #####    #####      #####
 ###### ######    #####      #####
  ############    ######     #####
   ############    ######     #####

Login:manager
Password: ******

Login successful

--> console enable
Switching from CLI to console mode - type 'exit' to return

192.168.2.1> snmp
192.168.2.1 snmp> _
```

Figure 57. AT-AR240E console – SNMP module

How to close the console

To close a session enter the following commands (*see Figure 58*):

```
- home + [enter]
```

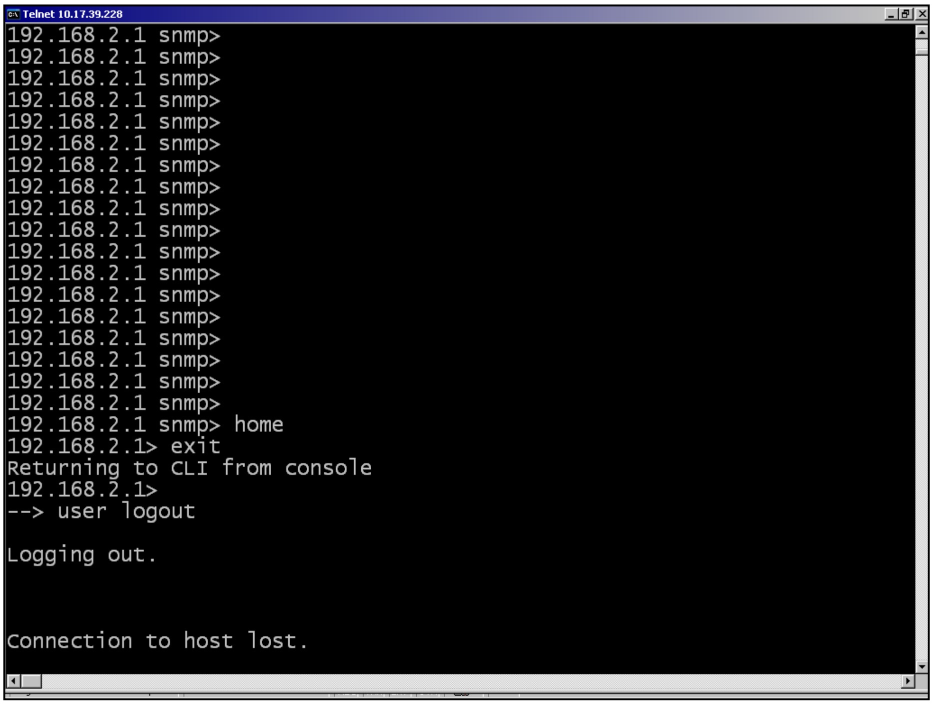
(for moving from the SNMP console section to the main console section)

```
- exit + [enter] + [enter]
```

(for moving from the console section to the home section)

```
- user logout + [enter]
```

(to close the telnet session)



```
192.168.2.1 snmp>
192.168.2.1 snmp>
192.168.2.1 snmp>
192.168.2.1 snmp>
192.168.2.1 snmp>
192.168.2.1 snmp>
192.168.2.1 snmp>
192.168.2.1 snmp>
192.168.2.1 snmp>
192.168.2.1 snmp>
192.168.2.1 snmp>
192.168.2.1 snmp>
192.168.2.1 snmp>
192.168.2.1 snmp>
192.168.2.1 snmp>
192.168.2.1 snmp>
192.168.2.1 snmp>
192.168.2.1 snmp>
192.168.2.1 snmp> home
192.168.2.1> exit
Returning to CLI from console
192.168.2.1>
--> user logout

Logging out.



Connection to host lost.
```

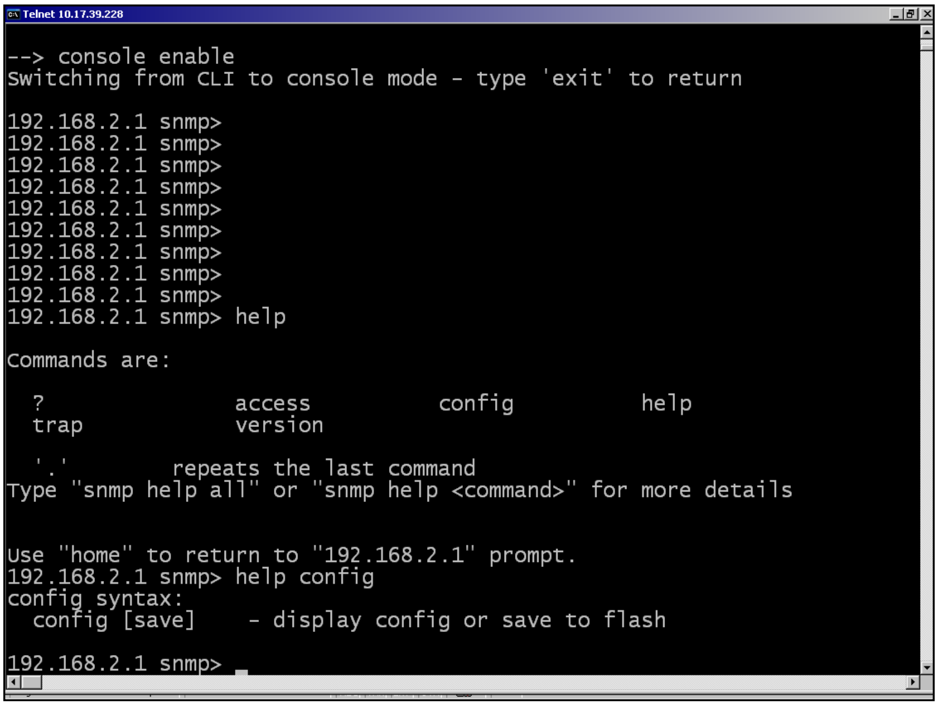
Figure 58. How to close the console

HELP on SNMP console commands

An online help is provided for all the SNMP provided commands that are:

- `access`
- `config`
- `trap`

To have access to the Online help (*see Figure 59*) simply type “`help`” followed by the “`command name`” (e.g. `help config`)



```
--> console enable
Switching from CLI to console mode - type 'exit' to return

192.168.2.1 snmp>
192.168.2.1 snmp>
192.168.2.1 snmp>
192.168.2.1 snmp>
192.168.2.1 snmp>
192.168.2.1 snmp>
192.168.2.1 snmp>
192.168.2.1 snmp>
192.168.2.1 snmp>
192.168.2.1 snmp> help

Commands are:

  ?               access          config          help
  trap            version

  '.'        repeats the last command
Type "snmp help all" or "snmp help <command>" for more details


Use "home" to return to "192.168.2.1" prompt.
192.168.2.1 snmp> help config
config syntax:
  config [save]    - display config or save to flash

192.168.2.1 snmp> _
```

Figure 59. SNMP commands online help

Command Reference

SNMP ACCESS

Syntax

```
snmp access [read | write] <community> [<IP addr>]
snmp access delete <community> [<IP addr>]
snmp access flush
snmp access list
```

Description

These commands are used for the following scopes:

To allow `read-only` or `read-write` access for some `<IP addr>` based on the `community` string value

To revoke specified address

To revoke all access

To list all the allowed access

Defaults

By default the SNMP is provided for read and write with the following accesses:

```
snmp read public
snmp write friend
```

Examples

To allow the snmp read access for IP address 151.30.21.22 using "testsnmp" as community string:

```
snmp access read testsnmp 151.30.21.22
```

To change from the default value (that is "friend") to the new value "test" the SNMP write community string:

```
snmp access delete friend
snmp access write test
```

SNMP CONFIG

Syntax

```
SNMP CONFIG SAVE
```

Description This command saves the SNMP configuration into the flash.

SNMP TRAP

Syntax

```
snmp trap add <community> <IP addr> [<port>]
snmp trap delete <community> <IP addr> [<port>]
snmp trap flush
snmp trap list
```

Description These commands are used for the following scopes:
To add a trap destination using an IP addr and port
To delete a trap destination
To delete all trap destinations
To list trap destinations

Examples To add the `151.30.21.22` as destination for trap using "`testsnmp`" as community name:

```
snmp trap add snmptest 151.30.21.22
```

SNMP VERSION

Syntax

```
SNMP VERSION
```

Description This command shows that software varsion of the SNMP module.

☞ *This is not related to the SNMP version supported that is v.1*

APPENDIX A

ATM is a standard that supports the integration of voice, data, & video, and allows for the guarantees of service quality from end-to-end.
The following describes the reasons why ATM has become a popular service, and goes on to describe some of the details of the operation of ATM.

Factors underlying the design of ATM.

Traditionally there have been quite separate networks for different types of traffic. Telephone companies had their synchronous networks for carrying phone calls (ie 'voice traffic'). Wide-area data traffic was carried over Frame Relay, X.25 and PPP networks. Local-area traffic was carried on an Ethernet or token-ring network.

All these different network types have developed to be well suited to the sort of traffic that they most frequently carry.

For example, voice traffic is very intolerant to delays and changes in timing. So when many voice calls are combined (multiplexed) onto a single line, the method used is "Time-Divided Multiplexing" (TDM). Ie the transmission medium of logically divided into a series of time slots, and each call is allocated a slot. Therefore, each call is guaranteed to be able to send a specific amount of data every second – i.e a constant fixed end-to-end bandwidth.

A frame-relay network, on the other hand, multiplexes different data streams in a packet-switched manner – individual packets from different streams are interleaved onto a single transmission line. If the transmission line becomes over-subscribed, then packets have to be dropped. The decision of which packets to drop is made on the basis of the different service agreements that have been made with different customers (ie what Quality of Service the customers have bought). So, there is not a constant end-to-end bandwidth, but the more money you pay, the more likely you are to get your data through at peak times. Given that wide-area bandwidth is typically expensive, a significant premium is usually charged for a high Quality of Service. So, the majority of customers have to simply accept the fact that file transfers, etc will take longer at peak times.

An Ethernet is treated as a network of peers – every workstation has equal access to the line. At peak times, its just first-in-first-served. Also, Ethernet is an asynchronous medium – a workstation can start transmitting data at any moment it chooses; it does not need to wait for a particular clock signal.

LAN/WAN/Voice integration

The Internet is the first multimedia source to the desktop and this immediately breaks all the pre-existing rules. Internet applications such as voice and real-time video require better, more predictable LAN and WAN performance. I.e for successful transmission of voice and data, LANs and WANs need to be able to provide a service more closely akin to the fixed, constant end-to-end bandwidth of a telephone network.

So, a need arose for a transport mechanism that could achieve the reliable transmission required by voice and video, but also made optimum use of available bandwidth.

Cell multiplexing

ATM was designed as the transport mechanism to satisfy these conflicting requirements. One of the key elements in ATM is the concept of the data cell. A stream of bits is broken up into discrete packets or cells, each of which has a header indicating its path and other worthwhile information. If the cell size is made small, and the overall throughput of the circuit is high, delay-sensitive traffic can be carried along with bursty types of data successfully, and everyone gets what they need from the data link. Voice and video work without glitches, and data customers (potentially) get bandwidth-on-demand.

Cells are multiplexed onto a line – each of the competing data streams gets turns at putting cells onto the line. The decision as to who gets the next turn is governed by the Quality-of-Service rules that have been configured on the multiplexing switch.
So, “Cell multiplexing” provides a compromise between:

- the time-divided multiplexing of voice networks, which does not make optimum use of the available bandwidth, as it simply leaves time-slices empty of there are periods of silence on the call
- the packet switching of frame relay or X.25, which introduces delays if a small packet get caught behind some large packets.

Each ATM cell consists of 53 bytes. The first 5 bytes contain cell header information, and the remaining 48 contain the “payload” or user information.

Other significant features of ATM

Traffic engineering features

ATM offers improved performance through an ability to offer performance guarantees and robust WAN traffic management that support the following capabilities:

- Large buffers that guarantee Quality of Service (QoS) for bursty data traffic and demanding multimedia applications
- Per-virtual circuit (VC) queuing and rate scheduling
- Feedback congestion notification

Encapsulation of protocols

Standards have been developed to enable ATM to encapsulate all manner of protocols – layer2 and layer3. So, IP can be directly encapsulated in ATM, or IP can be sent encapsulated in Ethernet, which, in turn is encapsulated in ATM.

This provides a flexibility in network design – Ethernets can be transparently bridged across an ATM network, or data can be routed, depending on what best suits the application that is being used.

Scalability

ATM has been designed in such a way that it can, and has, be adapted to a variety of different physical media and data rates. At the physical layer, ATM supports multimode optical fiber, single mode fiber, STP, coaxial cable, and UTP, at throughputs as high as 10Gbits/sec.
ATM traffic can readily fit into SONET or SDH (Synchronous Digital Hierarchy, the international superset of SONET standards) data streams - the 155Mbits/sec single- and multimode fiber physical layer standards are based on SONET frames. A 45Mbits/sec standard for the DS3 interface, which uses coaxial cable, has also been defined. DS3 facilities are much more widely installed in North America than SONET facilities. At 100Mbits/sec, ATM can use the physical standards defined for FDDI.

An ATM network is also scalable in terms of the number of network nodes. Ie. The performance of the network does not significantly decrease as the number of nodes and circuits in the network increases, because the cells are rapidly switched, using the information contained in the cell header.

BASIC STRUCTURE OF ATM NETWORK

ATM is based on the concept of two end-point devices communicating by means of intermediate switches. An ATM network is made up of a series of switches and end-point devices. The end-point devices can be ATM-attached end stations, ATM-attached servers, or ATM-attached
routers.
There are two types of interfaces in an ATM network:

- User to Network Interface (UNI)
- Network to Network Interface (NNI)

The UNI connection is made up of an end-point device and a private or public ATM switch. The NNI is the connection between two ATM switches.
The UNI and NNI can be carried by different physical connections.
The connection-oriented nature of ATM is an important reliability and quality feature. As a packet enters the ATM network, the packet destination is signaled and the network negotiates the reachability and quality of packet delivery. This packet "contract" guarantees the originator of reaching its intended destination with the required quality of service. If the network is unable to meet the demand or contract, the packet will not enter the network and a rejection message will be sent back, allowing the originator to pursue alternative paths.

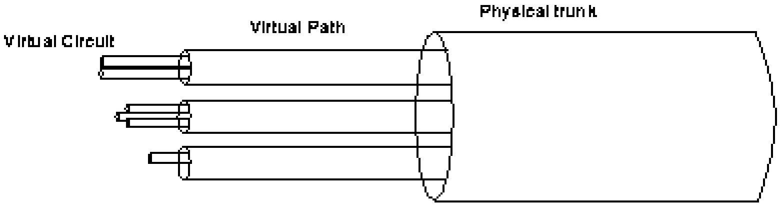
Because ATM is connection-oriented, a connection must be established between two end points before any data transfer can occur. This connection is accomplished through a signaling protocol. The connection is referred to as a virtual channel, and is assigned a Virtual Channel Indentifier (VCI) when it has been established.

ATM SERVICES

Three types of ATM services exist: permanent virtual circuits (PVC), switched virtual circuits (SVC), and connectionless service. PVCs allow direct connectivity between sites. In this way, a PVC is very similar to a leased line.
Among its advantages, a PVC guarantees the availability of a connection and does not require call setup procedures between switches.
Disadvantages of PVCs include static connectivity and manual setup.
An SVC is created and released dynamically and remains in use only as long as data is being transferred. In this sense, it is similar to a telephone call.
Dynamic call control requires a signaling protocol between the ATM endpoint and the ATM switch.
The advantages of SVCs include connection flexibility and call setup that can be handled automatically by a networking device (and does not need to be manually configured).
Disadvantages include the extra time and overhead required to set up the connection.

ATM VIRTUAL CONNECTIONS

ATM networks are fundamentally connection oriented, which means that a virtual channel (VC) must be set up across the ATM network prior to any data transfer. (A virtual channel is roughly equivalent to a virtual circuit.)
Two types of ATM connections exist: virtual paths, which are identified by virtual path identifiers, and virtual channels, which are identified by the combination of a VPI and a virtual channel identifier (VCI).
Virtual Path Identifier/ Virtual Circuit Identifier.



The relationship between Virtual Circuits and Virtual Paths

Routing is performed using a two layer hierarchical scheme. The higher layer involves virtual paths and switching according to the VPI only. A particular virtual path may carry a number of different virtual channels corresponding to individual connections. When switching is performed according to the VPI all cells on that particular virtual path are switched regardless of VCI. An ATM switch may route according to VCI, VPI or VCI and VPI.

An example of how this routing scheme may be useful is setting up a virtual path across a public ATM network between two sites. All cells from one site to the other will follow the same virtual path. Within each site routing will be performed according to the VCI.

ATM and Quality of Service

ATM Networks are designed to transmit data with varying characteristics.
Different applications need various Qualities of Service (QoS). Some applications like telephony may be very sensitive to delay, but rather insensitive to loss, whereas others like compressed video are quite sensitive to loss.

Using the Web interface it is possible to define the following different connection types, each of which is characterized by a different expected Quality of Service (QoS):

- CBR (Constant Bit Rate)
- VBRrt (real-time Variable Bit Rate)
- VBRnrt (non-real-time Variable Bit Rate)
- ABR (Available Bit Rate)
- UBR (Unspecified Bit Rate)

Let us look at the characteristics of these connection types.

UBR (unspecified bit rate)

The UBR service class is intended for delay-tolerant or non-real-time applications, i.e., those which do not require tightly constrained delay and delay variation, such as traditional computer communications applications. Sources are expected to transmit non-continuous bursts of cells.
UBR service supports a high degree of statistical multiplexing among sources.
UBR service includes no notion of a per-VC allocated bandwidth resource.
Transport of cells in UBR service is not necessarily guaranteed by mechanisms operating at the cell level. However it is expected that resources will be provisioned for UBR service in such a way as to make it usable for some set of applications. UBR service may be described by interpretation of the common term "best effort service ". The user does not have to provide some characterization of the source.

CBR (constant bit rate)

The CBR service class is intended for real-time applications, i.e. those requiring tightly constrained delay and delay variation (jitter), as would be appropriate for voice and video applications. The consistent availability of a fixed quantity of bandwidth is considered appropriate for CBR service. Cells which are delayed beyond the value specified by CTD(cell transfer delay) are assumed to be significantly less value to the application.
During a connection setup CBR connection reserves a constant amount of bandwidth. The source is allowed to send at the negotiated rate any time and for any duration. It may temporarily send at a lower rate as well.

Real time VBR

The real time VBR service class is intended for real-time applications, i.e., those requiring tightly constrained delay and delay variation, as would be appropriate for voice and video applications. Sources are expected to transmit at a rate which varies with time. Real-time VBR service may support statistical multiplexing of real-time sources, or may provide a consistently guaranteed QoS.
An rt-VBR connection negotiates the Peak Cell Rate (PCR), the Sustainable Cell Rate (SCR) and the Maximum Burst Size (MBS) and an upper bound delay (Max CTD).

Non-real time VBR

The non-real time VBR service class is intended for non-real time applications (file transfer, etc.). Non-real time VBR service supports statistical multiplexing of connections.

The connection nrt-VBR are characterized from a value of peak (PCR), one relative to medium band (SCR) and from an other one of the maximum dimension of acceptable Burst (MBS). The difference from the rt-VBR connection is that for the nrt-VBR connection, a Max CTD is not required.

ABR (available bit rate) and QFC

Many applications have the ability to reduce their information transfer rate if the network requires them to do so. Likewise, they may wish to increase their information transfer rate if there is extra bandwidth available within the network. There may not be deterministic parameters because the users are willing to live with unreserved bandwidth. The ABR service is designed to fill this need. Is very like the UBR service, except that it provides some feedback to the sending deviceThe network provides information about the available bandwidth and the state of congestion. The source's transmission rate is adjusted in function of this feedback information. This more efficient use of bandwidth alleviates congestion and cell loss. For ABR service, a guaranteed minimum bandwidth (MCR) is negotiated during the connection setup negotiations.

Traffic Parameters

The above descriptions of the connection types mention a number of parameters that have to be negotiated for various of the connections. These are collectively referred to as the Traffic Parameters. Let us look in more detail at how these parameters are implemented on the AT-AR240E.

Peak Cell Rate (PCR)

The parameter PCR of a virtual ATM connection represents the maximum speed at which it is possible to send traffic on the connection.
This parameter has the same limits for all traffic classes.
Maximum: the value of PortSpeed (i.e. the maximum rate in cells per second of the port).
Minimum: this is configurable. By default the minimum is PortSpeed/1000 per second. So this is about 2cps (cells per second) for an ADSL rate port.
(The range of values on the AT-AR240 is: [3,2500])

Minimum Cell Rate (MCR)

None of the traffic classes available on the AT-AR240E implement MCR.
There is a channel attribute, but this is just a place-holder: setting it has no effect.

Sustainable Cell Rate (SCR)

This is ignored unless the traffic class is VBR. For VBR, the SCR limits are the same as the PCR limits (*see above*). But SCR must be set less than PCR (this is enforced by the parameter checking code).
(The range of values on the AT-AR240 is: [2,2499])

Maximum Burst Size (MBS) and Burst Tolerance (BT)

These only affect VBR classes.
The two are not independent variables. The burst tolerance is a time (as per the traffic management spec.), the units being in cell times at the port speed.
So the two are related by:

$$BT = \frac{MBS * PortSpeed}{SCR} - \frac{MBS * PortSpeed}{PCR}$$

The basic limits are:
the MBS cannot exceed 5000

the BT is stored internally by the shaping code as a 16-bit value in microseconds, so the maximum burst time in practice is about 0.065s.

So the practical maximum burst size at 2000cps is about 130 cells. The minimum is zero.

The values of both BT and MBS will reflect whichever of the two was last set.
(The range of AT-AR240 is: [0,5000])

APPENDIX B

RFC1483 Bridged/Routed

RFC1483 defines the encapsulations used for multiplexing multiple protocols over ATM. The RFC1483 Bridged/Routed connections both use the encapsulations defined in that RFC to send the data across the ADSL line.

The difference between a bridged connection and a routed connection lies in the way that the packets are encapsulated. In a bridged connection, the entire Ethernet packet that arrives from the LAN is encapsulated and sent over the wide-area link. On the other hand, in a routed connection, the IP data is first extracted out of the Ethernet packet. It is only the IP data that is then encapsulated in the ATM.

This means, of course, that a Bridged connection can transfer protocols other than IP, but cannot be used for an Internet connection. It can only be used for an inter-office connection.

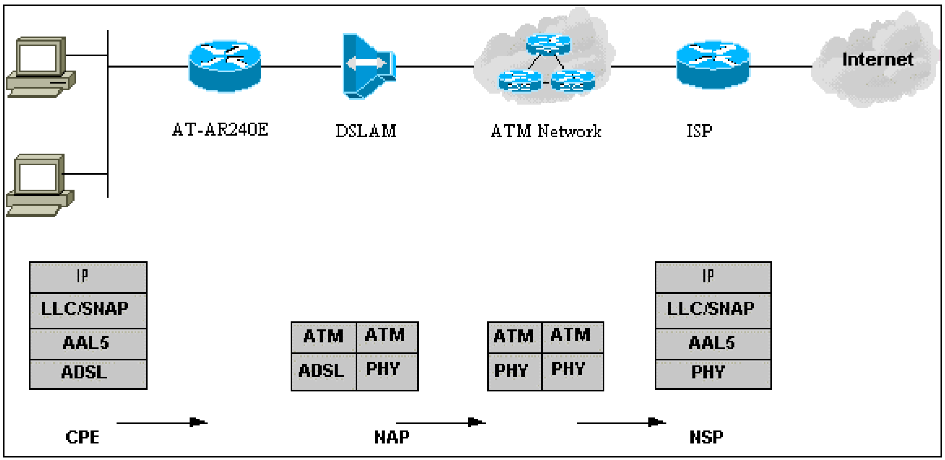
Data processing sequence

In an RFC1483 connection the user data coming from the PC's enters the AT-AR240E LAN Port. The Ethernet packet (in the case of a bridged connection) or IP packet (in the case of a routed connection) can be then encapsulated into a Logical Link Control/Subnetwork Access Protocol (LLC/SNAP) header, or not (VCMUX) which in turn is encapsulated in ATM adaptation layer 5 (AAL5) and handed over to the ATM layer.

The diagram below shows the data path in case that an LLC/SNAP header is used.

The ATM cells are then modulated by the ADSL transmission technology, and sent over the wire to the DSLAM. At the DSLAM, these modulated signals are first received by the POTS splitter, which is used to differentiate phone calls from data.

After it identifies the signals as belonging to a data connection, it passes them to the ADSL Transmission Unit Central Office (ATU-C) in the DSLAM.
The ATU-C demodulates the signal and retrieves the ATM cells, which are then passed to the network interface card (NIC) in the multiplexing device (MUX). The NIC looks at the subscriber side VPI/VCI information in the ATM header and makes the switching decision to another VPI/VCI which will be forwarded to the service destination router.



Data path in an RFC1483 Bridged/Routed Connection

APPENDIX C

IP Over ATM

In appendix B, there is a description of the RFC1483 routed connection, in which an IP packet is encapsulated in ATM and send over the line.
Here we will describe the more elaborate IPoA service, in which an ATM network acts as a multi-drop IP network, and the ARP protocol can be used to find the network node that has a particular IP address.

The inherent complexity in defining an IP network over ATM

The success of Asynchronous Transfer Mode (ATM) lies largely in its ability to transport legacy data traffic, mostly IP, over its network infrastructure. The complexity of interoperating IP with ATM originates from following two major differences between them.

Connection-oriented vs. Connectionless

ATM is connection-oriented, that is, a connection needs to be established between two parties before they can send data to each other. Once the connection is set up, all data between them is sent along the connection path.
On the contrary, IP is connectionless so that no connection is needed and each IP packet is forwarded by routers independently, on a hop-by-hop basis.
When we need to transport IP traffic over an ATM network, we have two options.

1) A new connection is established on demand between two parties;
2) The data is forwarded through preconfigured connection or connections.

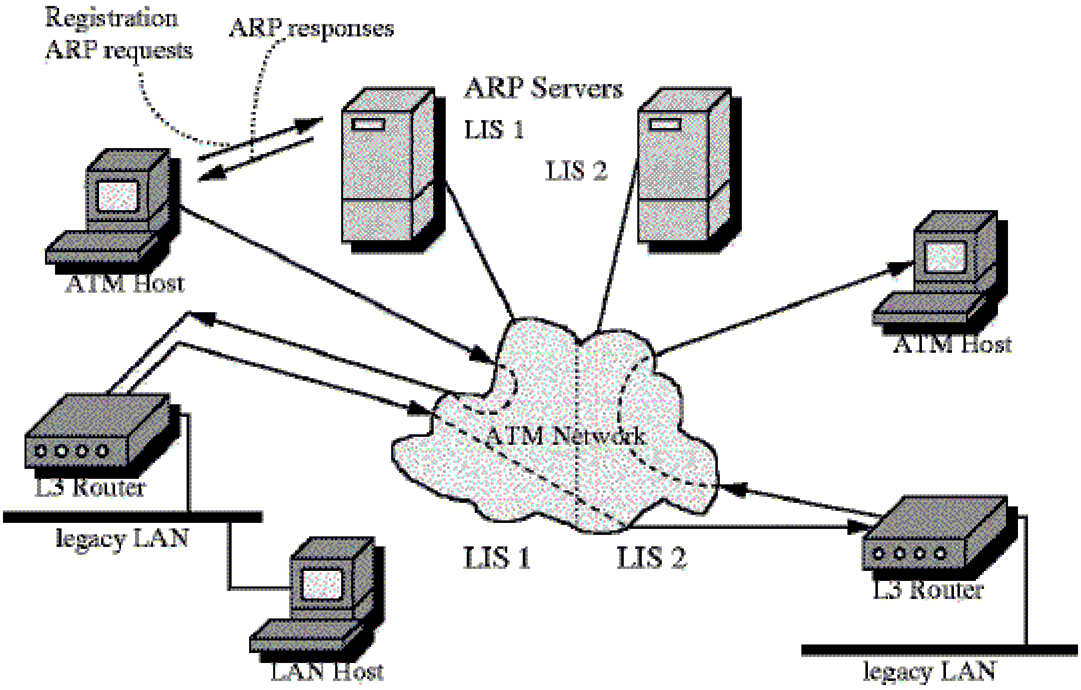
With the first approach, when the amount of data to be transfered is small, the expensive cost of setting up and tearing down a connection is not justified. On the other hand, with the second approach the preconfigured path(s) may not be an optimal path and may become overwhelmed by the amount of data being transfered.

QoS-aware vs. Best Effort

Quality of Service is an important concept in ATM networks. It includes the parameters like the bandwidth and delay requirements of a connection. Such requirements are included in the signaling messages used to establish a connection.
Current IP (IPv4) has no such concepts and each packet is forwarded on a best effort basis by the routers. To take advantage of the QoS guarantees of the ATM networks, the IP protocol need to be modified to include that
information.

How IPoA operates

IP over ATM treats the ATM network as a number of separate IP subnets connected through routers. Such an IP subnet is called a logical subnet (LIS) as shown in figure below.



IP over ATM architecture

A LIS has the following properties

- End systems in an LIS share the same IP prefix and address mask. In this way LIS is quite similar to a traditional IP subnetwork over a broadcast LAN. However, traditional IP subnetworks are separated from each other by routers while LISs are actually connected to the same ATM network. This explains why it is called logical subnet: the membership of an LIS is defined by software configuration, not by hardware settings. Also this implies that inter-LIS communication need not necessarily go through a router.
- End systems in an LIS communicate with each other through end-to-end ATM connections. When an end system A needs to communicate with an end system B, which is in the same LIS, it needs to establish a connection with B first. A has B 's IP address but does not know its ATM address. To resolve the IP addresses into ATM addresses, as in traditional IP subnets, each LIS contains an ARP server, called an ATMARP server. A sends a ARP query packet that contains B 's IP address to the ATMARP server and the server will reply to it with B 's ATM address. A then establishes a connection with B through P-NNI signaling.

Routing between LISs

End systems in different LISs communicates with each other through a router. As in traditional IP subnets, a router is a member of multiple LISs and forwards IP traffic between them. Typically, each LIS contains a router and all IP packets that are not destined for an end system in the same LIS are forwarded to the router. If the router is in the same LIS as the destination end system, it forwards the packet to the destination end system using the scheme described above (intra-LIS). Otherwise it forwards the packet to another router and the packet is routed to the destination on a hop-by-hop basis.

Traffic across LIS boundaries must be forwarded by a router which is a member of both LISs even though it might be physically possible to establish a direct VC connection between the source and destination (i.e. they have a physical connection at the ATM level).

This is not desired since each router has to reassemble and disassemble the IP packet and this introduces unnecessary delay. This is universally acknowledged as one of the weaknesses of the IPoA model.

APPENDIX D

Point to Point Protocol

The arrival of low cost broadband technologies in general and DSL (Digital Subscriber Line) in particular has greatly increased the number of computer hosts that are permanently connected to the Internet. This has increased concerns on the part of DSL service providers about security. Computers connected to the Internet via DSL do so through an Ethernet link. As such, plain TCP/IP has been used, with no additional protocols. Modem dial-up connection, on the other hand, use PPP (Point to Point Protocol) which provides secure login, and traffic metering among other advanced features. PPPoE (PPP over Ethernet) was designed to bring the security and metering benefits of PPP to Ethernet connections such as DSL.

PPP is an acronym for Point to Point Protocol. It is a member of the TCP/IP suite of network protocols.

PPP is an extension to TCP/IP that adds two additional sets of functionality: it can transmit TCP/IP packets over a serial link and it has login security

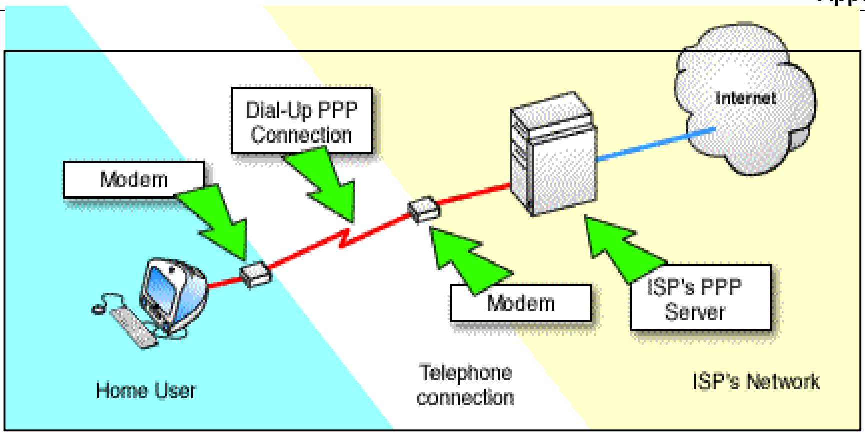
TCP/IP by itself cannot be transmitted over a serial link. This makes it unsuitable for WANs (Wide Area Networks).

Telecommunications companies however offer serial communications links around the globe right now and have done so for many years. To make TCP/IP work over these serial links, it was necessary to create a protocol that could transmit TCP/IP packets over serial lines. The two protocols that do this are:

- SLIP (Serial Line Internet Protocol)
- PPP

PPP is more feature rich and has largely supplanted SLIP.

When serial links that are part of the public telephone system are used, care must be taken to ensure the authenticity of all communications. To this end PPP incorporates user name and password security. Thus, a router or server receiving a request via PPP where the origin of the request is not secure, would require authentication. This authentication is part of PPP. Because of its ability to route TCP/IP packets over serial links and its authentication capabilities, PPP is generally used by Internet Service Providers (ISPs) to allow dial-up users to connect to the Internet.



PPP is used by Internet Service Providers (ISPs) to allow dial-up users to connect to the Internet.

PPP over ATM

With ATM over ADSL, the residential and small business office customers have access to broadband Internet environments. ATM over ADSL provides seamless connections from remote users to any ATM distribution network, to any ATM backbone, to any corporate intranets, or to the Internet. In addition, ATM provides direct connection to Internet/intranet servers, such as a security server, an Internet content caching server, or a video server. This enhances Internet services, in terms of performance, load sharing, and redundancy.

Furthermore, the use of ATM as the layer 2 protocol over the ADSL access network offers some distinct advantages.

- Protocol transparency: The network is independent of the layer 3 protocol (IP, IPX, etc.) used. In some countries, protocol transparency is also required by regulatory constraints.
- Support of multiple QoS classes and capability to guarantee levels of QoS: ATM delivers the capability for the network operator to differentiate the network services based on QoS classes mapped to user profiles or applications.
- The fine-grained bandwidth scalability of ATM: The scalability of ATM matches the rate adaptiveness of ADSL, hence allowing optimal use of each copper loop.
- Evolution to different xDSL members: Using ATM with ADSL is an opportunity to pave the way for evolving access technologies, such as VDSL.

Once ATM layer connectivity is established between the customer premise and the service provider network, the session setup and release phases at the link level and network level can be established using PPP. The definition of a standard for PPP over ATM will increase the utility of ATM as an access technology.

Essential operational functions can be delivered over ATM using features well established in PPP:

- Authentication (PAP, CHAP, token-based systems)
- Layer 3 address autoconfiguration (e.g., domain name autoconfiguration, IP address assignment by the destination network)
- Multiple concurrent destinations (i.e., multiple PPP sessions)
- Layer 3 transparency (e.g. both IP and IPX are currently supported on PPP)
- Encryption
- Compression
- Billing, usage metering, and interaction with RADIUS servers

Adapting the PPP suite to ADSL can happen with little or no extra effort and will accelerate delivery of interoperable service architecture. PPP over ATM is even more valuable because it adheres to the narrowband service model currently driving the ISP business.

APPENDIX E

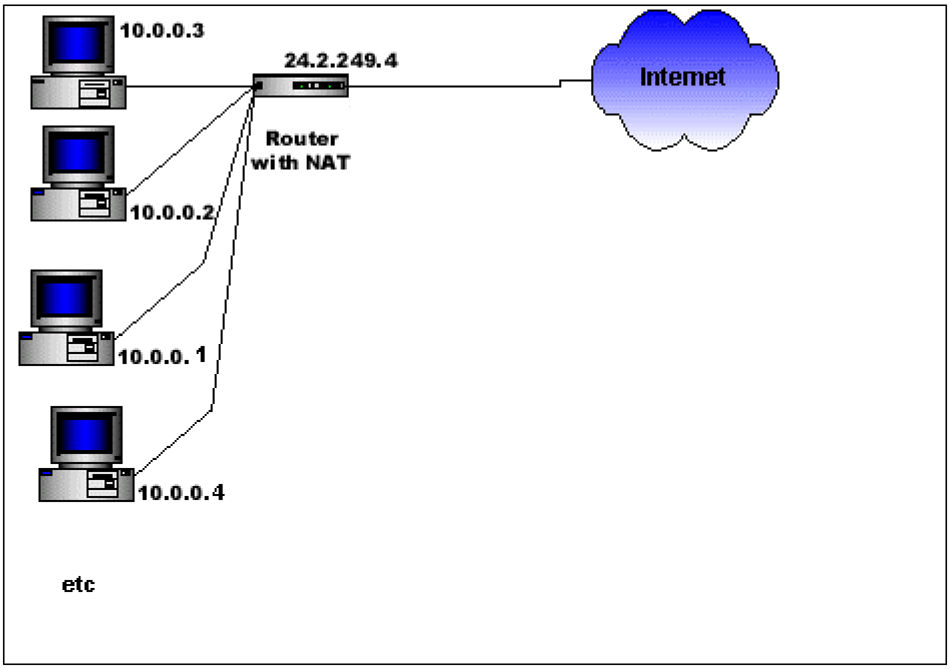
Network Address Translation

NAT stands for Network Address Translation. In short, it is a mechanism by which the IP addresses of packets are changed as they go through a routing device. The reason for doing such a translation is to enable a device to appear to have one address to hosts on one side of the NATing router, and another address to hosts on the other side of the NATing router.

At first glance, it might seem a very strange thing to want to change the addresses inside IP packets. However, there are some useful applications for this, briefly explained in the following.

Address conservation

The most common application of NAT is to make better use of the increasingly scant resource that is the public IP address. As the number of people connecting to the Internet has exploded, it has reached the stage where there are just not enough IP addresses available to give an individual address to every Internet-connected device. So, a prime purpose of NAT is to enable a whole network to access the Internet using just a single public IP address (*see figure below*).



Address Conservation using NAT

Security

The security provided by NAT is really a by-product of the address conservation purpose. The fact is that NAT aims to translate the source addresses of packets originating from within the local private network; when reply packets come back from the Internet, they can be passed back to the hosts on the Private network as the NAT process keeps an internal table that enables it to know which replies are actually destined to which private hosts.

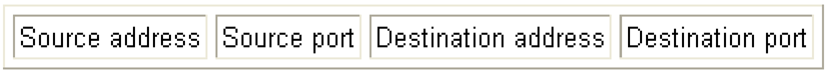
So, if a packet comes from the Internet that is not a reply to a packet sent from the inside, then that NAT process does not know who to forward it to, and has to drop it.

So, this makes it very difficult for devices on the Internet to initiate incoming sessions to hosts on the private network; when the packet that is trying to initiate the session arrives at the NAT device, it gets dropped.

In addition, because the NAT process has to process all the packets passing through it, in order to pass them to the right internal host, it is quite easy to build in an ability to look for attacks – SYN floods, Pings of Death, IP Spoofing etc are quite easy to recognize as packets are being examined on the way through the NAT device.

How does NAT work?

The trick to NAT is to make use of the Port fields in TCP and UDP.
In TCP and UDP packets, there are 4 fields that identify a particular session:



Source address	Source port	Destination address	Destination port

The particular value of the source port number in a session is not important, so the NAT device is free to change the source port numbers in packets. This freedom to change the source port number is the central key to NAT. This enables it to make sure that every TCP or UDP session that it sends out to the Internet has a UNIQUE source port number.

Consider the problem that would occur if the NAT device was not free to change the source port number; only the source address:

> If two hosts on the private LAN happened to create sessions using the same source port number, and same destination address and same destination port number, then the only thing that would be different between the packets in one session and those in the other session would be the source IP addresses. However, once the NAT device had changed the source IP addresses to the global IP address, there would be nothing to differentiate the packets. The host at the other end of the connection would think that all the packets were from the same session, which would cause chaos.

So, it is very important that the NAT device is also able to change the source port number, so that the problem described above will never happen.

Therefore the NAT device can intercept TCP and UDP sessions coming from Private hosts, change the source addresses AND source port numbers in the packets, and store away the original IP address and port number in a table, along with the newly substituted port number (so that the original values can be restored in the reply packet when it comes).

So, the process that occurs is :

- the NAT device receives the packet
- changes the source IP address in the packets to the global IP address
- looks up in its table for an entry containing the source port number and original source address of the packet
  - if it finds an entry, it takes the substitution port number in the table entry, and changes the source port number of the packet to this substitution number
  - if it does not find an entry, it generates a new substitution port number, and creates a new table entry containing the original source IP address of the packet, its original source port number, and the newly generated substitution port number. Changes the source port number of the packet to this substitution number.
- Sends the packet on out the public interface.
- <the packet goes off to the destination host, which sends a reply, in which source and destination IP address are swapped, and source and destination port number are swapped>
- the reply packet arrives back at the NAT device, which receives it
- the destination port number is looked for in the table

- if it is found, the packet is recognized as being a reply for an existing session, and the source IP and source Port number in the table entry are put into the destination IP address and destination port number fields of the packet, and the packet is then sent onto the private LAN.
- If it is not found, then it is not clear where the packet should be sent, and so it is dropped.

What about protocols other than UDP and TCP?

The description above involves a lot of use of port numbers. Unfortunately, the port-number fields are only present in TCP and UDP packets. For other IP protocols, like ICMP, OSPF, GRE, IPSEC, etc other methods have to be used.

In the case of ICMP, things are a little more complicated. For Ping packets, there is an identifier field in the packet, that uniquely identifies each ping – NAT can make use of this field in a similar way to the UDP/TCP port number. For other ICMP information messages (port unreachable, host unreachable, etc) there are often IP addresses of the hosts inside the data section of the packet - there is extra work required for the NAT device to look inside the ICMP packet, and translate these addresses as necessary.

For most other IP protocols, though, there usually is not a field in the packet that can uniquely identify a communication session (and therefore, which host on the LAN to send the replies to). So, usually, a static mapping (probably user configured) has to be used – e.g. a mapping like 'all GRE packets arriving at the public interface, with a particular destination address, will be sent to a particular address on the private LAN'.

So, there typically just is not the flexibility with the other protocols that there is with TCP and UDP.

How can you let sessions into servers on the private LAN?

Up until now, we have been looking at the situation where a host on the private LAN initiates a session to some external host. So, the NAT device intercepts the packets on the way out, and is associating source port numbers with internal IP addresses.

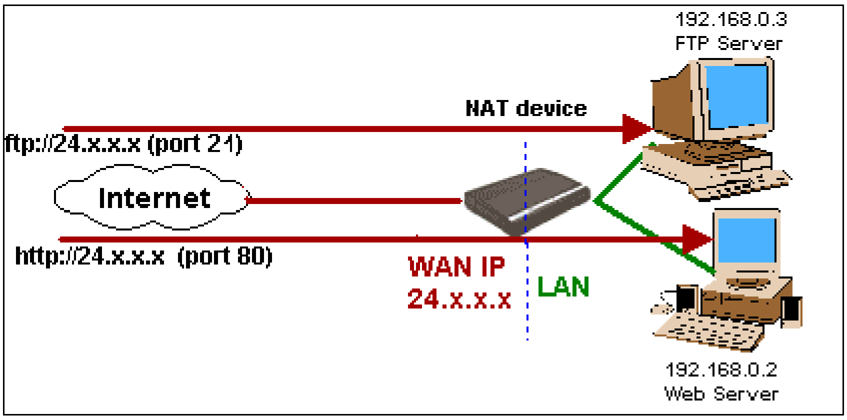
However, what about the case where an external host wants to connect to a host on the Private LAN? This session will, of course, be initiated by an incoming packet arriving at the public interface. It has been stated above that in general, such a packet will have to be dropped – if it is not a reply to an outgoing packet, there is no information about which internal host to forward it to.

However, you may wish to actually make it possible for incoming sessions to access certain hosts on the private LAN. This has to be done by configuring specific static port mappings. For example, a mapping can be configured such that any TCP session coming into port 80 on the public interface is forwarded to a particular host on the private LAN; and any TCP session coming into port 25 on the public interface is forwarded to another (or maybe the same) host on the private LAN, and so on.

In this way, servers on the private LAN can be made available for connections from external hosts. Of course, for any given port number, only one mapping is possible – so it is only possible to make one Web Server, one Mail Server, one FTP server, etc available.

In the diagram below, we see a case of allowing external access to an FTP server and a WWW server. This would be achieved by have two static mappings on the NAT device:

Incoming sessions to TCP port 21 are mapped to internal IP address 192.168.0.3
Incoming sessions to TCP port 80 are mapped to internal IP address 192.168.0.2



External access to an FTP server

APPENDIX F

AT-AR240E Remote management

The software upgrade procedure is based on TFTP (Trivial File Transfer Protocol). The AT-AR240E equipment acts as a TFTP server which accepts connections on UDP port 69 while the host from which you are performing the upgrade acts as a TFTP client.
The upgrade procedure can always be activated from LAN or USB; if it is activated from WAN some further issues apply which depend on the NAT configuration.
If NAT is not configured the upgrade procedure works.
If NAT is configured, a reserved mapping on UDP port 69 must be defined, otherwise the equipment cannot be reached via TFTP.

To perfom the software upgrade the following environment is recommended:

1- Linux PC running RedHat 7.0 or later
2- `TFTP client` package installed (release 0.17 or later)
3- a bash shell

The upgrade procedure is a simple bash script.
It must be executed with two command-line parameters, which are the IP address of the AT-AR240E interface, and the name of a tar file containing a set of files which have to be updated.
The command syntax is the following:

```
upgrade.sh <IP address> <TAR file>
```

The upgrade procedure performs some operations and forces two subsequent reboots.

If the AT-AR240E is obtaining its IP address dynamically, then it is possible that it might obtain an address different to that which you specified on the command line for `upgrade.sh`.
If this occurs, then the upgrade will fail. So you must ensure that your IP address allocation process is configured in such a way as to ensure that the router will be re-allocated the same IP address when this reboot occurs.

If the upgrade procedure is interrupted the web server could remain out of service for a maximum period of 5 minutes.

If the upgrade procedure is interrupted during the updating of flash the equipment reboots with a corrupted image and enters in a recovery state. If this happens the software can be upgraded only locally, i.e. from LAN or USB.

Find below the script file as reference.

```
#!/bin/bash
touch_file ()
{
      touch $1
      if [ $? != 0 ]; then
            echo "cannot write file $1"
            exit
      fi
      return 0
}
wait_for_target_alive()
{
      while (true) do
            ping -c 1 $1 > /dev/null
            if [ $? != 0 ]; then
                  echo "wait"
                  sleep 3
                  continue
            fi
            break
      done
}
clean_up()
{
      rm -f services
      rm -f tftplock.key
      rm -f tftp.rbt
      rm -f tftplock.web
      rm -f tftpupdt.dir
      rm -f tftpupgr.beg
      rm -f tftpupgr.end
      rm -f tftpupgr.rbt
}
if [ "$1" == "" -o "$2" == "" ]; then
      echo "usage: upgrade <ip addr> <tarfile>"
      exit
fi
if [ ! -f "$2" ]; then
      echo "usage: upgrade <ip addr> <tarfile>"
      echo "tarfile not found"
      exit
fi
ipaddr=$1
tarfile=`basename $2`
clean_up
```

```
#
# write some files needed to communicate with TFTP server
#
echo "friend" > tftplock.key
if [ $? != 0 ]; then
      echo "cannot write file tftplock.key"
      exit
fi
touch_file tftp.rbt
touch_file tftplock.web
touch_file tftpupdt.dir
touch_file tftpupgr.beg
touch_file tftpupgr.end
touch_file tftpupgr.rbt
#
# Is AR240e alive ?
#
echo "1. Trying to ping AR240e..."
wait_for_target_alive $ipaddr
#
# Is the tftp server reachable ?
#
echo "2. Check if TFTP server is up..."
tftp $ipaddr > /dev/null <<-FIRST_STEP
      binary
      timeout 20
      put tftplock.key
      get services
FIRST_STEP
if [ ! -s services ]; then
      echo "TFTP server unreachable"
      exit
fi
#
# Now lock the web server
#
echo "3. Locking web server..."
tftp $ipaddr > /dev/null <<-SECOND_STEP
      binary
      rexmt 60
      put tftplock.key
      put tftpupdt.dir
      put tftplock.web
      put tftp.rbt
SECOND_STEP
if [ $? != 0 ]; then
      echo "Cannot lock web server"
      exit
fi
echo "4. Waiting for restart..."
sleep 5
wait_for_target_alive $ipaddr
#
# Now we make the upgrade
#
echo "5. Software upgrading..."
tftp $ipaddr > /dev/null <<-THIRD_STEP
      binary
      put tftplock.key
      put tftpupgr.beg
      put $2 $tarfile
      put tftpupgr.end
THIRD_STEP
if [ $? != 0 ]; then
      echo "Software transfer failed"
      exit
fi
#
# Wait for a while...
#
clean_up
echo "6. Updating flash..."
sleep 70
echo "7. AR240 is now restarting: software upgraded"
```

APPENDIX G

AT-AR240E – How to update the software using the TFTP software

The AT-AR240E software is composed of two main portions:

- the recovery image
- the software image

A TFTP software is provided in order to upload both the recovery and the software images. All the necessary steps for uploading the software are described below:

How to upload the recovery

1) configure your PC network card with the following IP Address: `192.168.1.2`
2) connect your PC Ethernet port directly to the Router Ethernet port using a standard patch cable
3) load the recovery image into the router following these steps:

3.1) select the `at-ar240e_<sw-release>/phase1_recovery` directory of the CD;
3.2) double click on the `dslflash.exe` application
3.3) wait for 100 secs
3.4) once the "`Flashing completed`" sign appears, click on OK
3.5) power OFF the router
3.6) power ON the router

How to upload the software image

1) configure your PC network card with the following IP Address: `192.168.1.2`
2) connect your PC Ethernet port directly to the Router Ethernet port using a standard patch cable
3) load the software image into the router following these steps

    3.1) select the `at-ar240e_<sw-release>/phase2_software` directory of the CD
    3.2) double click on the `dslflash.exe` application
    3.3) wait for 100 secs
    3.4) once the "`Flashing completed`" sign appears, click on OK
    3.5) power OFF the router
    3.6) power ON the router

Now you should be able to browse into the router, which is running the new software.
Username and password values will have reverted to the defaults:

```
Username: manager
Password: friend
```

APPENDIX J

Troubleshooting

This section of the manual is to help you to resolve some operational problems that you could meet when using the AT-AR240E.

Troubleshooting Tips

Following are answers to common end-user problems.

Noise on phone line.

- Verify that the noise is audible through more than one phone. Noise on a single phone is typically a result of the phone itself and not DSL service.

- Determine if a DSL filter is installed at the premises. DSL filters are required to use the AT-AR240E with all telephony devices.

- Determine if other data transmitting devices are present. Fax machine and analog modem transmissions often "bleed" over substandard wiring.

No light on the AT-AR240E are lit, or light are indicating an error.

- If the power led is not lit, verify that there is power to the AT-AR240E. If you have plugged the AT-AR240E into another electrical receptacle, verify if there is a switch that may control the electrical receptacle in use.

- If the ADSL led is not lit, verify the ADSL cable is plugged into the AT-AR240E line connector, and then if the ISP has the ADSL service enabled on your line.

- If the ethernet led is not lit:

if you are using an usb pc-AT-AR240E connection then it is correct for ethernet led to not be lit.

If you are using an ethernet pc-AT-AR240E connection, verify that an ethernet cable connects the AT-AR240E to your pc, this cable has to be connected between the AT-AR240E ethernet connector and the pc ethernet connector. Then verify if the pc ethernet card is enabled. If the problem is still present try to use another ethernet cable.

- If the three leds present on the AT-AR240E are all lit, but neither the ADSL port nor the ethernet port is connected to anything, try to reset the device, turn it off and then on again, if the problem is still present please contact the supplier of your AT-AR240E.

It is impossible to comunicate with the AT-AR240E.

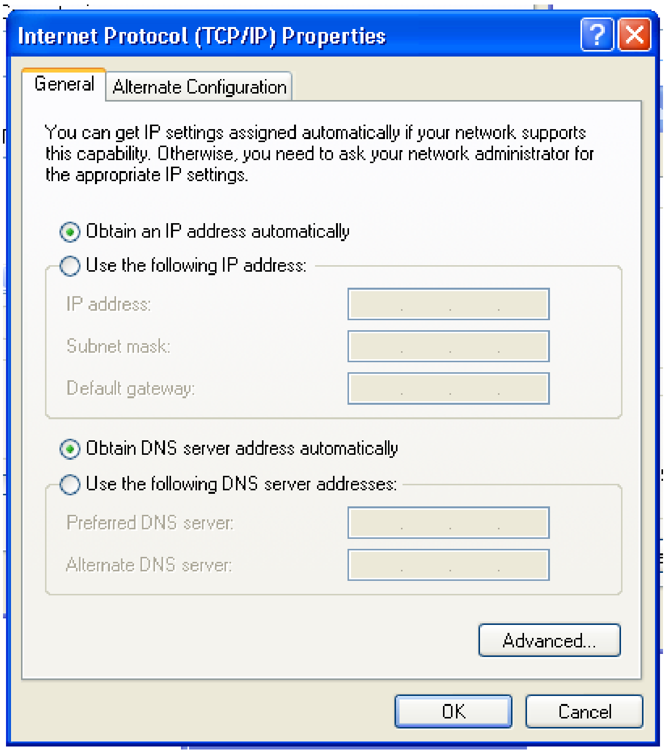
- Verify the AT-AR240E is on, and the ethernet cable(or USB cable) is correctly connected to both the pc and the AT-AR240E.

- Verify the IP address and the subnet of your pc. It has to be in the same IP subnet as the AT-AR240E. The default IP subnet of the AT-AR240E is 192.168.1.0 for the LAN interface, and 192.168.2.0 for the USB interface.

- Note that the Web Server in the AT-AR240 is not accessed on the usual WWW TCP port (port 80), but is accessed on a special port number – 8080. Therefore it is important that the full string http://192.168.1.1:8080 is typed into the address field of the web browser when making a connection to the AT-AR240. If you leave off the http:// part, or leave off the :8080 part, the connection will fail.

It is impossible to obtain an IP address from the AT-AR240E DHCP Server.

- Verify if your pc is set up for dynamic IP assignement (use DHCP).I.E. the TCP/IP properties for your ethernet card should look as below:



You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.

● Obtain an IP address automatically

○ Use the following IP address:

IP address: . . .

Subnet mask: . . .

Default gateway: . . .

● Obtain DNS server address automatically

○ Use the following DNS server addresses:

Preferred DNS server: . . .

Alternate DNS server: . . .

- Verify if the AT-AR240E DHCP server is enabled; to do this you will have to:

  set on your pc a static IP address that belongs at the same IP subnet as the AT-AR240E (for the LAN interface the defualt IP subnet is 192.168.1.0, and for the USB interface the defualt IP subnet is192.168.2.0) for example, use 192.168.1.2 when using an ethernet connection to the AT-AR240E

  use your by IE browser to navigate to the AT-AR240E GUI(192.168.1.1),

  check the DHCP Server cofiguration

If the DHCP Server is enabled, and no address is assigned to the pc, try to reset the device, turn it off and then on again.

It is impossible to browse to internet sites or ping hosts on the WAN network.

- On the AT-AR240E GUI check the following:

  On the status page if the virtual led for the ADSL line is green.

If an IP address has been assigned to the Wan connection (if dynamic IP assignement is being used)

The VCI, VPI values are the same as those given to you by the ISP

If the RX and TX values on the ATM connection are non zero.

- Verify by the AT-AR240E GUI if, in the DNS Relay section of the DNS page, the IP address for the DNS Server is correct. (This value is obtained automatically when you choose “use DHCP” for RFC1483 routed and IpoA connections, or choose “autoDNS discovery” for PPP routed connections. In any case it has to be set to a value given by the ISP).

- If you are using a routed ADSL connection on the AT-AR240E, and your WAN interface has been assigned a public IP address, then you will need to enable the NAT funcionality in order to be able to reach the Internet.

- Verify, if you are using the AT-AR240E Firewall functionality, there is a filter for the TCP port 80 that is set to “allow” for outbound sessions (to browse on internet), or there is a filter for the ICMP protocol to allow outgoing ICMP messages (to allow outbound pings).

It is impossible for external hosts to access a Server on the internal network.

- Verify that, if you are using the NAT functionality, a Reserved Mapping entry is present in the NAT section, to specify the destination address for incoming sessions to the server (e.g a reserved mapping for TCP port 80 for a WWW server, or TCP port 21 for an FTP server, etc).

- Verify that, if you are using the AT-AR240E Firewall functionality, there is a filter to allow incoming TCP sessions to the relevant TCP port.(e.g. a filter to allow incoming TCP to port 80 for a WWW server, or incoming ICMP to ping the server etc)

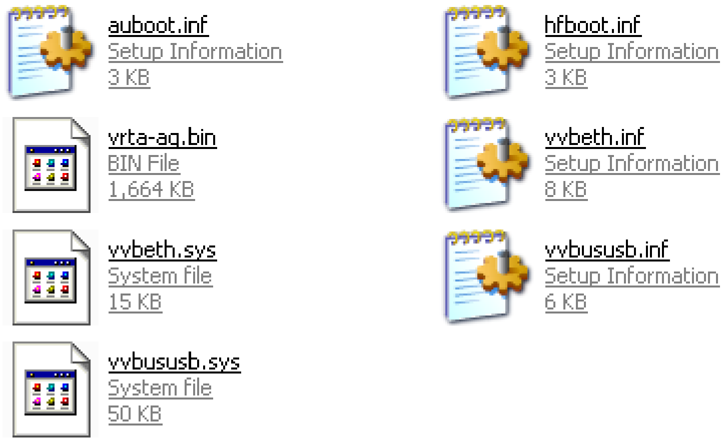
- If you are using the NAT or firewall functionality, and the connections to the Internal server are FTP or Netmeeting connections, then check that that Dynamic Port Opening items have been defined for the relevant connection types.

APPENDIX K

Installing the USB driver

Before you can access the AT-AR240E via its USB interface, it is necessary to install the USB software driver for the AT-AR240.

The driver files are provided with the AT-AR240, there will be a directory on the accompanying CD containing the files, as shown below:



auboot.inf
Setup Information
3 KB

hfboot.inf
Setup Information
3 KB

vrta-aq.bin
BIN File
1,664 KB

vvbeth.inf
Setup Information
8 KB

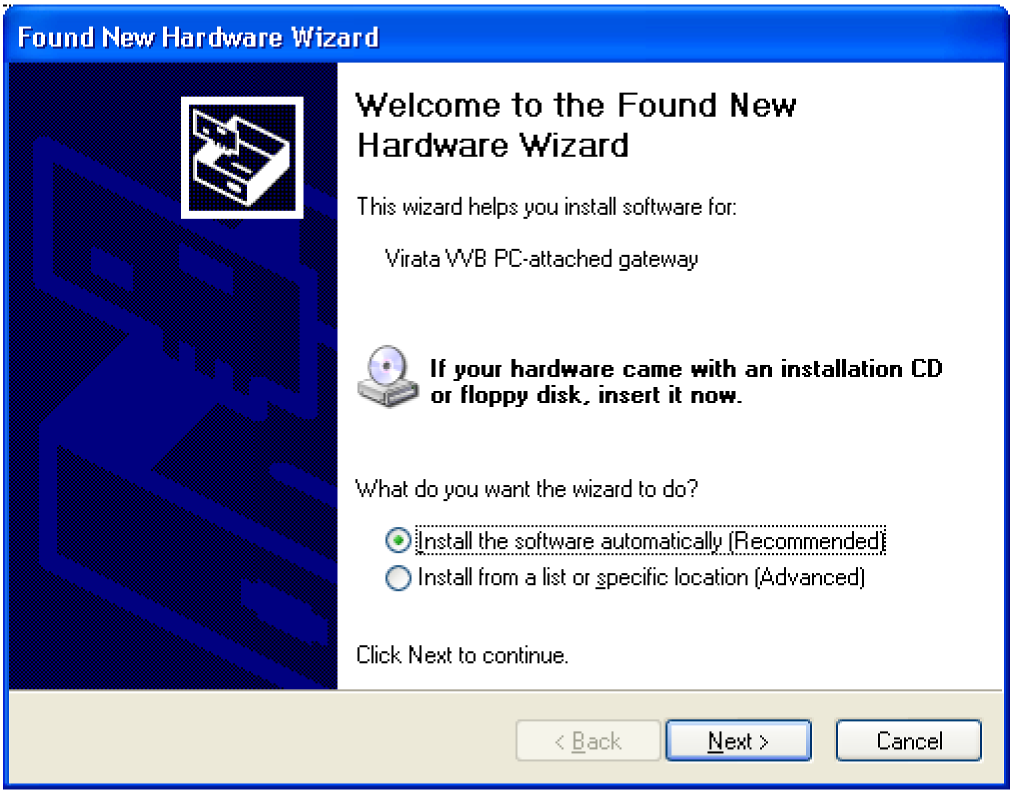
vvbeth.sys
System file
15 KB

vvbususb.inf
Setup Information
6 KB

vvbususb.sys
System file
50 KB

To install the drivers, proceed as follows:

Connect the AT-AR240E to the PC, using a USB cable. The PC will detect the presence of a new hardware device connected to it, and will pop up a dialog box similar to:


Found New Hardware Wizard

Welcome to the Found New Hardware Wizard

This wizard helps you install software for:

Virata VVB PC-attached gateway

If your hardware came with an installation CD or floppy disk, insert it now.

What do you want the wizard to do?

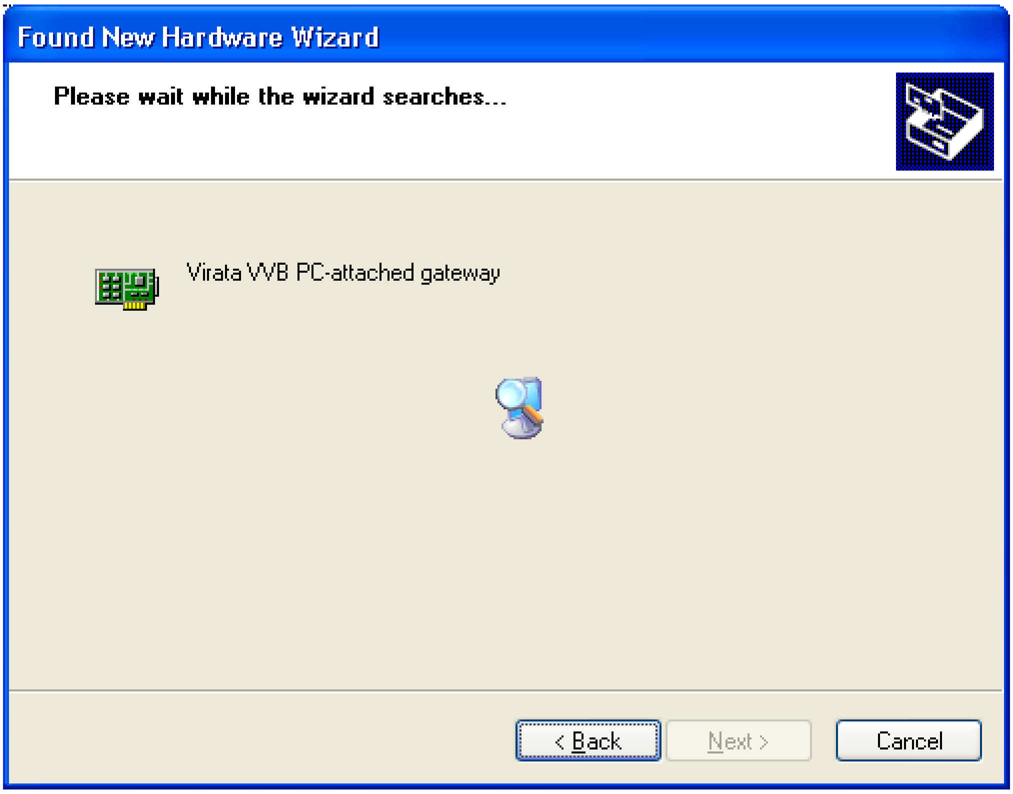
● Install the software automatically (Recommended)

○ Install from a list or specific location (Advanced)

Click Next to continue.

The dialog box illistrated here is from Windows XP, the exact appearance of the dialog will be different for different versions of Windows.

Ensure that the CD containing the AT-AR240E USB driver files is inserted into the PC, then click on the next button, and the PC will search for the driver files:



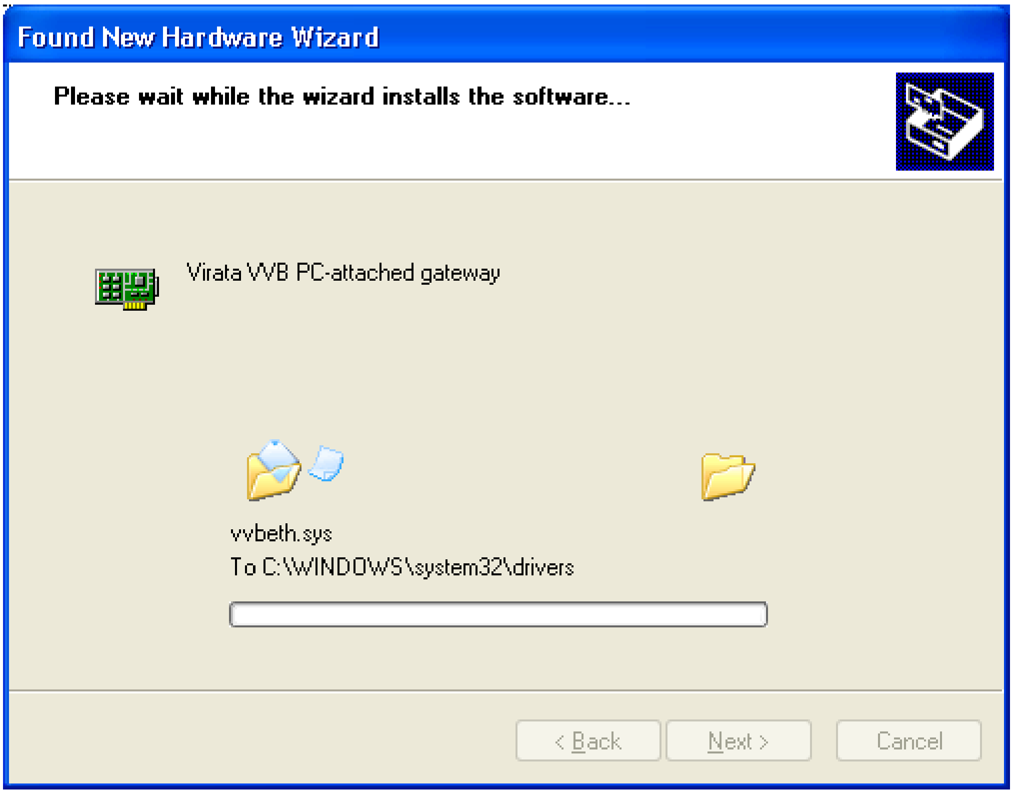
Found New Hardware Wizard

Please wait while the wizard searches...

Virata VVB PC-attached gateway

If the PC fails to find the files, click the Back button from this window, and then in the previous window, choose the option “Choose from a list or specified location”. Then click on Next, and you will be given the opportunity to browse to the directory where the files reside.

Once the PC has found the driver files, it will install them into a system directory:



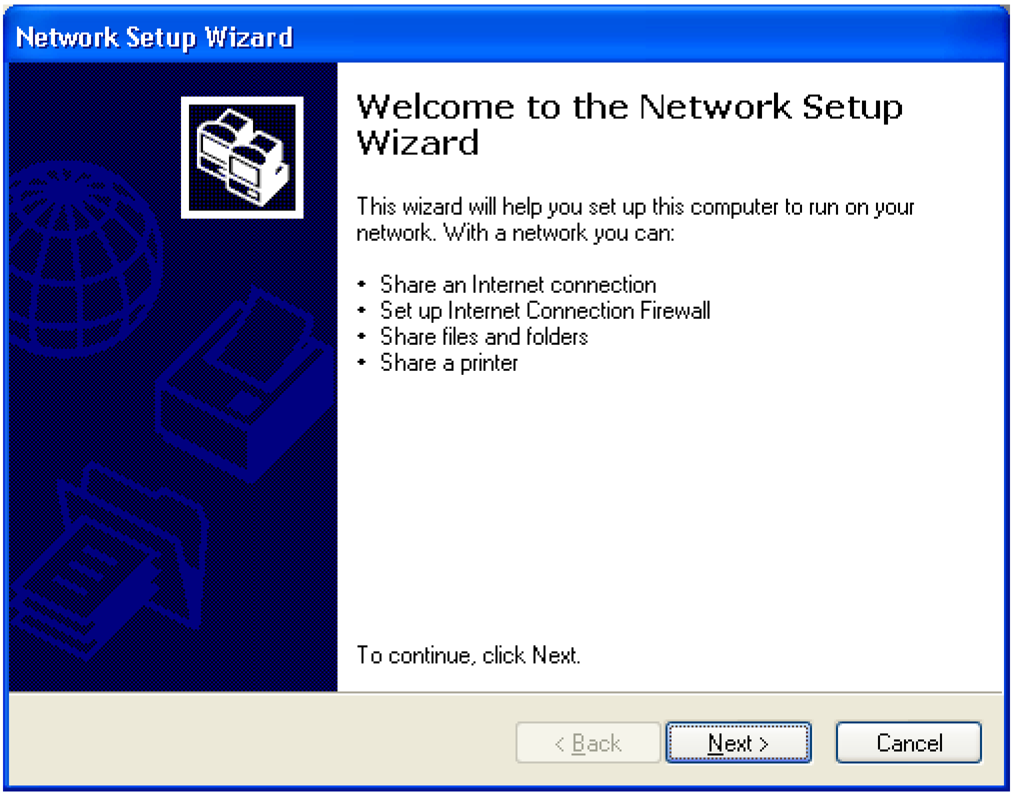
Found New Hardware Wizard

Please wait while the wizard installs the software...

Virata VVB PC-attached gateway

vvbeth.sys
To C:\WINDOWS\system32\drivers

When the installation is complete, you will be presented with the opportunity to set up Networking using this new connection:



Network Setup Wizard

Welcome to the Network Setup Wizard

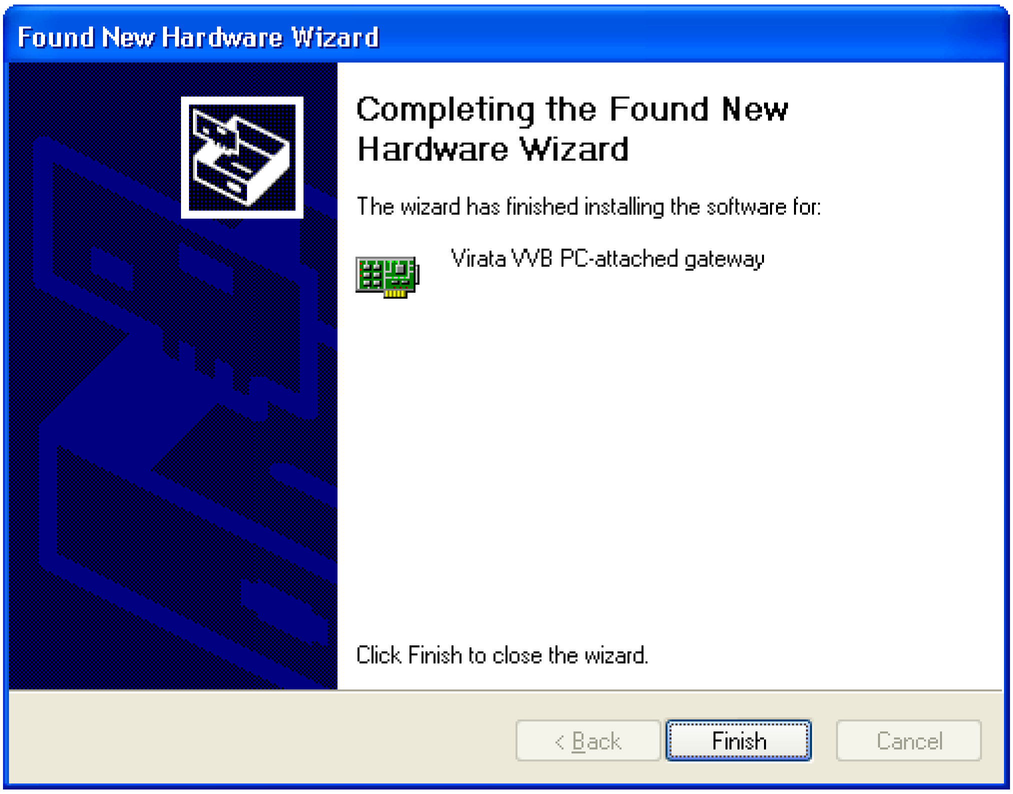
This wizard will help you set up this computer to run on your network. With a network you can:

- Share an Internet connection
- Set up Internet Connection Firewall
- Share files and folders
- Share a printer

To continue, click Next.

At this point, click the Cancel button. If you do not, Windows will make fundamental changes to your networking setup, which may change you desired settings. By the time you reach this dialog, the drivers are installed, and the PC can communicate with the AT-AR240E using the IP protocol, which is all that you require.

The installation is now complete, you will be presented with an "Installation Complete" dialog:



Found New Hardware Wizard

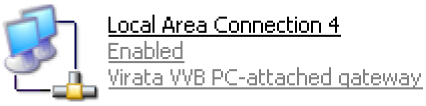
Completing the Found New Hardware Wizard

The wizard has finished installing the software for:

Virata VVB PC-attached gateway

Click Finish to close the wizard.

If you check the Network Connections section of the control panel, you will see that there is now a new network connection present:



Local Area Connection 4
Enabled
Virata VVB PC-attached gateway

The name of this connection may differ from that illustrated above.

This connection has the IP protocol enabled, and is set to learn an IP address by DHCP. So, it will obtain an IP address from the DHCP server in the AT-AR240E. It should now be possible to connect to the

AT-AR240E using your web browser (the default IP address on the USB interface of the AT-AR240E is 192.68.2.1, and so would be accessed by typing http://192.168.2.1:8080 into the "Address" field of the web browser).